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(54) Medical pump monitoring system

Steueranordnung für eine medizinische Pumpe

Appareil de commande pour pompe médicale

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(56) References cited:
EP-A- 0 960 627
US-A- 4 291 692
US-A- 5 338 157
US-A- 5 544 661
US-A- 5 651 775

- **PATENT ABSTRACTS OF JAPAN vol. 017, no. 270 (C-1063), 26 May 1993 (1993-05-26) & JP 05 007623 A (SHARP CORP), 19 January 1993 (1993-01-19)**

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a medical pump monitor system according to the preamble of claim 1.

BACKGROUND OF THE INVENTION

[0002] Varieties of therapies and drugs for use in those therapies have emerged and administration methods have become complicated due to recent advancement of medical treatments. Accordingly, therapies in which a plurality of medical pumps (syringe pump and infusion pump) is used at a time for one patient are on the increase. Also, systems managing the flows of administered medical fluids from plurality of such medical pumps and alarm information such as a drop in residual low battery /occlusion of an infusion line have been proposed.

[0003] A system in which visual contact is made with the displayed states of alarms in such a medical pump system is disclosed in Japanese Patent Laid-open No. 5-7623 specification.

[0004] A schematic diagram of a system in which medical pumps independent of one another are connected to a personal computer via communication cables, and flow volumes and alarm information of the medical pumps are collected and displayed as application software of the personal computer is shown in FIG. 2.

[0005] Also, a schematic diagram of a type of a pump monitor system in which pumps share a power supply line and a data communication line with one another through a power connector 53 and a communication connector 54, and medical pumps 51 and 52 are connected in such a manner that they are stacked one after another on a base unit 55 comprising a display unit 101 on which the flow and alarm information for each pump is shown in FIG. 3.

[0006] Furthermore, in the case of such a system, in addition to collection of pump information, control such as stop/start of infusion by pumps and change of flows can also be performed from the personal computer and the base unit.

[0007] FIG. 2 shows a conventional medical pump system, wherein reference numeral 20 denotes a personal computer with system application software installed therein, reference numeral 21 denotes a display device (display unit) such as a CRT and a liquid crystal monitor connected to the personal computer, reference numeral 22 denotes communication port expanding means such as a multiplexer for expanding communication ports of RS 232C that are typically provided with only one or two channels to 4 channels, 8 channels or the like, and reference numerals 23, 24, 25 and 26 denote medical pumps. Also, reference numeral 27 denotes a patient, and medical pumps of 23 to 26 deliver individual set liquid medicines into the patient.

[0008] FIGS. 4 A to 4C show cases where the same number of medical pumps as in FIG. 2 are used to perform administration for one patient, wherein their administration paths are different from one another due to the condition of the patient, administrated drugs and the like. For example, FIG. 4A shows a case where four pumps each have individual infusion lines and drugs are injected into different points of the patient, and FIG. 4B shows a case where two infusion lines of four medical pumps are connected with each other and the other two infusion lines are also connected with each other. Also, FIG. 4C shows a case where four medical pumps are all integrated into one line to carry out administration for the patient.

[0009] It is important in safe administration that the state of the infusion line is ascertained correctly, and there are various patterns as to states of infusion lines as administration passes to the patient in this way, but in fact, it becomes very difficult to identify the points of the patient into which the medical fluid is injected if infusion lines running from a plurality of pumps are connected with one another and cross one another.

[0010] However, conventional pump monitor systems have no functions to display infusion lines on the system, thus making it difficult to ascertain the state of infusion lines correctly.

[0011] Also, on the other hand, when a system in which one or more external apparatuses (hereinafter also referred to as "slaves") such as infusion pumps, syringe pumps, blood-pressure monitors and urinary volume monitors are connected to a host machine to manage and display the operation conditions of the apparatuses is built, works of:

(1) setting a communication protocol of nodes
(2) sending a request command
(3) receiving data and confirming the reception
(4) carrying out control in accordance with data are performed at the host machine side.

[0012] As a matter of course, the loads on the CPU of the host machine are increased if these processing are performed at high speed, and real time quality is compromised if a large number slaves are connected. Also, even if a system is made such that processing is distributed over a plurality of CPUs like a CPU (main CPU) engaged in processing of controlling and displaying slave conditions in the host machine and CPUs (sub CPUs) engaged in communication with each slave, enormous development costs are required for both main and sub CPUs due to addition of slaves and change of specifications, although processing at the main CPU is slightly curtailed.

[0013] EP-A-0960627, US-A-5338157 and JP-A-05-007623 disclose medical pump monitor systems in accordance with the first part of claim 1.

SUMMARY OF THE INVENTION

[0014] The present invention has been made in the

light of problems as described above, and its object is to provide a system in which the operation conditions of a plurality of medical pumps are monitored for one patient with a function of creating and editing an infusion line from the pump to the patient on each-by-each basis, and display information created and edited by means of this function on the system, thereby making it more easy to confirm the current states of infusion lines.

[0015] Another object is to provide a function of capturing hand written diagrams and so on together with the function of creating and editing the infusion line, and an operator is allowed to make a choice on whether the function of creating and editing the infusion line is used to create the infusion line, or handwritten diagrams and so on are captured in the system to display the same, thus making it possible display various cases of the infusion line on the medical pump monitor system.

[0016] Still another object is to provide a real-time monitoring system, a controlling method therefore and a program storage medium, which enable real-time monitoring of the operation states, arrangement/connection states, alarm information of a plurality of medical apparatuses such as infusion pumps, syringe pumps, blood monitors, urinary volume monitors, water contents of medical fluids, states of intake and output of electrolytes and so on.

[0017] The medical pump monitor system of the invention is set out in claim 1.

[0018] Other features and advantages of the present invention will be apparent from the following descriptions taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the descriptions, serve to explain the principle of the invention.

FIG. 1 shows a block diagram of a medical pump system in the first preferred embodiment of the present invention;
FIG. 2 shows a block diagram of the medical pump system in prior arts;
FIG. 3 shows a block diagram of a medical pump system of another embodiment in prior arts;
FIG. 4A shows one of block diagrams of infusion circuitry patterns in the first preferred embodiment of the present invention;
FIG. 4B shows one of block diagrams of infusion circuitry patterns in the first preferred embodiment of the present invention;
FIG. 4C shows one of block diagrams of infusion circuitry patterns in the first preferred embodiment of the present invention;
FIG. 5 shows a medical pump monitor screen in the first preferred embodiment of the present invention;
FIG. 6 shows a screen for creating infusion circuitry in a medical pump monitor system in the first preferred embodiment of the present invention;
FIG. 7A shows the screen for creating infusion circuitry in the medical pump monitor system in the first preferred embodiment of the present invention;
FIG. 7B shows the screen for creating infusion circuitry in the medical pump monitor system in the first preferred embodiment of the present invention;
FIG. 7C shows the screen for creating infusion circuitry in the medical pump monitor system in the first preferred embodiment of the present invention;
FIG. 7D shows the screen for creating infusion circuitry in the medical pump monitor system in the first preferred embodiment of the present invention;
FIG. 7E shows the screen for creating infusion circuitry in the medical pump monitor system in the first preferred embodiment of the present invention;
FIG. 7F shows the screen for creating infusion circuitry in the medical pump monitor system in the first preferred embodiment of the present invention;
FIG. 7G shows the screen for creating infusion circuitry in the medical pump monitor system in the first preferred embodiment of_the present invention;
FIG. 8 shows the screen for creating infusion circuitry according to another embodiment in the medical pump monitor system in the first preferred embodiment of the present invention;
FIG. 9 shows an example of a configuration of a control unit 100 in FIG. 1;
FIG. 10A is a flowchart showing a flow of infusion circuitry creation processing in the first preferred embodiment of the present invention;
FIG. 10B is a flowchart showing the flow of infusion circuitry creation processing in the first preferred embodiment of the present invention;
FIGS. 11A to 11C show an example of a monitor screen in the first preferred embodiment of the present invention; and
FIGS. 12A to 12C show an example of a monitor screen in the first preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0020] A specific embodiment of the present invention will be described below. A block diagram of a medical pump system is shown in FIG. 1. In this embodiment, an example of collecting and managing information of four medical pumps is described.

[0021] Reference numeral 100 denotes a controller (control unit) , which makes up a central portion of this medical pump monitor system, and for the controller, a personal computer having an inputting device such as a keyboard and a pointing device such as a mouse is usually used. Reference numeral 101 denotes a display (dis-

play unit), which displays flow values and alarm information for a plurality of medical pumps 103, 104, 105 and 106, collected by the controller 100, and the urinary volume from urinary volume meters 111 and the amount of electrolytes (Na^+, Ca^{2+}, K^+, Cl^-) from catheter type sensor 112, and displays infusion lines.

[0022] In the case where the personal computer is used as the controller 100, a CRT or a liquid crystal monitor is used for the display (display unit) 101. Reference numeral 102 denotes a scanner (reading means) for capturing handwritten information of infusion lines, and reference numeral 102a denotes a scanner for reading product identification information (such as bar codes), and they are connected to the controller 100. Reference numeral 107 denotes communication port expansion device (communication port expanding means) such as a multiplexer for multiplying communication ports when the controller 100 is poorly equipped with ports for communicating with pumps that collect data. The controller 100 is connected to medical pumps 103, 104, 105 and 106 via this communication port expansion device 107 using a communication cable (wired) 109 or is connected therewith wirelessly. The configuration of the controller 100 is, for example a configuration as shown in FIG. 9, which comprises a CPU 901, a RAM 902, a ROM 906, a HDD 909, a floppy disk (FD) 906a, a keyboard 904 and a mouse 905, and is connected to a display 101 and is connected via an I/F 903 to the scanner 102. It is further connected via an I/F 907 to the communication port expansion device 107. Also, it is connected to the host computer of a nurse station or the like through an external communication port 107a.

[0023] When the medical pump monitor system is started normally, the controller 100 urges an operator to select information of drugs to be administered by respective pumps from a drug database (drug library) file stored in the memory means in the controller 100. The operator (medical staff such as a doctor and nurse) selects drugs to be administered such as a vitamin solution for the pump 103, a physiological salt solution for the pump 104 and high calorie medical fluids containing electrolytes such as Na^+, Ca^{2+}, K^+, Cl^- for the pump 105. Alternatively, the operator inputs product identification information to the system as medical apparatus identification information (such as bar codes) stuck on respective medical pumps using the scanner 102a for respective medical pumps 103 to 106, and reads product identification information to the system as drug identification information (such as bar codes) 103b, 104b, 105b and 106b syringes 103a and 103b in which drugs are taken in predetermined minutes and which are connected to the pumps or fluid containers 105a and 106a connected to the pumps to make a check on whether or not the drug is one included in the drug database file of the controller 100. When the medical pump is not connected, voice information is given by voice informing means 908 for calling attention if it is a drug not included in the database file. The identification information of this pump and the drug identification information are stored in the RAM 902 as a pair, and are displayed together on the display unit 101 as shown in FIG. 5. When selection of drugs is completed, the controller 100 communicates with four pumps connected as medical pumps 103, 104, 105 and 106 in succession at a fixed time interval (for example one minute interval), wirelessly and/or with cables.

[0024] The communication is data for requesting information of current flows of administered fluids from respective medical pumps 103, 104, 105 and 106, and when the request data are received by the pumps, the pumps send back the flow information to the controller 100 in predetermined format. The controller 100 subsequently sends signals requesting alarm information to the connected medical pumps 103, 104, 105 and 106, and when they are received by the pumps, the pumps also send back the alarm information to the controller 100 based on a predetermined format. Furthermore, if there exists no alarm information, then a signal indicating no alarm information is sent back to the controller 100.

[0025] The controller 100 displays information from connected medical pumps 103 to 106 on the display (display unit) in such a manner that it is displayed along a pump information display area shown in FIG. 5. In FIG. 5, a region denoted by reference numeral 501 is a region in which operation states of medical pumps 103 to 106 are indicated by color, for example by green during normal operations (described with blank in this figure) , by red when an alarm is given (described with vertical lines in this figure), by yellow in the case when administration operations are interrupted (described with slashes in this figure) and by gray when the pump itself is not connected. Also, its contents (occlusion, abnormal flows, etc.) are displayed at the same time. A region denoted by reference numeral 502 is a region in which the flow value of the pump 103 is indicated. Reference numeral 503 denotes a region in which alarm information currently occurring in the medical pump 103 is indicated, and the region is blanked when no alarm is given. Reference numeral 504 denotes a region in which drugs that are administered are displayed. The system can be operated even if drugs to be administered are not defined, but in this case, the region is blanked.

[0026] In a similar way, reference numerals 511 to 514 denote regions in which information about the medical pump 104 is displayed, reference numerals 521 to 524 denote regions in which information about the medical pump 105 is displayed, and reference numerals 531 to 534 denote regions in which information about the medical pump 106 is displayed.

[0027] Reference numeral 540 denotes an infusion circuitry display region (infusion circuitry display unit), a region in which a graphic file stored in the controller 100 in predetermined format and file name is displayed. The graphic file may be a general graphic file such as a bit map file and a JPG file in the case where the controller 100 is a personal computer or the like. In this embodiment, a bit map file of 24 bits color with 640 dots (lateral

direction) × 480 dots (vertical direction) is stored in file name of "C:¥Yuekic.bmp".

[0028] In the case where any file to be displayed in the infusion circuitry display region 540 does not exist in the controller 100, nothing is displayed, or "No infusion circuitry file" is displayed at the center of the region.

[0029] Reference numeral 541 denotes a circuitry creation function calling button (circuitry creation function calling means), and by clicking (pressing) the button, an application for creating and modifying infusion circuitry and storing the same as graphic file data, as described later, is started. Reference numeral 542 denotes a circuitry read function calling button (circuitry read function means), and by clicking (pressing) the button, an application for reading a diagram of infusion circuitry and storing the same as graphic file data, as described later, is started. Furthermore, since both buttons 541 and 542 are expedient buttons displayed on the screen, the click (press) operations are operations of moving a pointer of a pointing device such as a mouse onto the button displayed on the screen and clicking the same.

[0030] A condition displayed in FIG. 5 is based on the assumption that a bit map file for displaying infusion circuitry is stored in advance, and information of the medical pump 103 is displayed in the regions 501 to 504. In a similar way, a square denoted by numeral 104 corresponds to the medical pump 104 of which information is displayed in the regions 511 to 514, a square denoted by numeral 105 corresponds to the medical pump 105 of which information is displayed in the regions 521 to 524, and a square denoted by numeral 106 corresponds to the medical pump 106 of which information is displayed in the regions 531 to 534.

[0031] By watching the diagram of infusion circuitry in the infusion circuitry display region 540, it can be understood that infusion lines 110 running from the medical pump 103 and the medical pump 104 are integrated into one line to form a first infusion line L1 to be fixed in administration position near the right brachium part of the patient 27, and infusion lines 110 running from the medical pump 105 and the medical pump 106 are integrated into one line to form a second infusion line L2 to be fixed in administration position near the left thigh part of the patient 27.

[0032] A diagram of infusion circuitry should be reregistered not only in cases where administration is started for a new patient, but also in cases where administration passes are changed due to change of drugs to be administered for long-term administration.

[0033] For registration of the diagram of infusion circuitry, a "C:¥Yuekic.bmp" file may be created anew. In this embodiment, the "C:¥Yuekic.bmp" file can be created either by clicking the circuitry creation function calling button 541 or by clicking the circuitry read function calling button 542.

[0034] When the circuitry creation function calling button 541 is clicked, a window is displayed on the display unit as shown in FIG. 6. The arrangement of the pumps 103 to 106 is displayed by selecting from a plurality of arrangement patterns stored in memory means that is the most suitable for the therapy for the patient. In FIG. 6, reference numerals 601 to 604 denote medical pumps as shown in the region 540 in FIG. 5. Reference numeral 27 denotes a model showing the body of the patient, reference numerals 606 to 613 around the patient 27 denote buttons (selecting means) for selecting the portion of the patient 27 into which injection is made by the infusion line, and reference numerals 606, 607, 608, 609, 610, 611, 612 and 613 correspond to a right clavicle, left clavicle, right brachium part, left brachium part, right forearm part, left forearm part, right thigh part and left thigh part, respectively.

[0035] Reference numeral 614 denotes a junction production button (junction producing means), reference numeral 615 denotes a button for making a return by one action in case of erroneous operations, and reference numeral 616 denotes an end button (end inputting means) for overwriting the infusion circuitry diagram graphic file "C:¥Yuekic.bmp".

[0036] From this screen, a procedure of creating an infusion circuitry diagram as shown in the region 540 in FIG. 5 will be described based on FIG. 6 and Figs 7A to 7G, in correspondence with a flow of processing shown in Figs 10A and 10B. For creating the infusion line, the start and end points of the line may be defined one after another. Furthermore, flowcharts shown in Figs 10A and 10B may be stored in a ROM 906 or a HDD 909 as a program, or may be stored in a CD-ROM, a DVD-ROM, a floppy disk or the like.

[0037] First, the medical pump 601 is clicked. When it is clicked, the medical pump goes into a selection state in which its displayed color is changed or it blinks (FIG. 6, S1003). Since the medical pump 601 is connected to the medical pump 602, the infusion line is created up to the junction 1 with the medical pump 602. For this purpose, the operator subsequently clicks the junction production button (junction producing means) 614 (S1003). Then, the junction is displayed just below the medical pump 601 with the junction being surrounded by a circle, and an infusion line 110 a is formed in the middle between the medical pump 601 and the junction 1 (FIG. 7A, S1004).

[0038] Since the medical pump 602 and the right brachium part of the patient 27 are connected to the junction produced at this time, then two lines may be drawn from this junction 1. For this purpose, the junction 1 surrounded by the circle is first clicked. In this condition, the junction 1 goes into the selection state (the color inside the circle highlighted, and so on), and subsequently a right brachium part selection button 608 is clicked (S1018). Furthermore, the order of clicking the junction and the right brachium part selection button in this case may be reversed. In this way, the first infusion line L1 is formed from the junction 1 to the right brachium part of the patient (state shown in FIG. 7B, S1019). Subsequently, the junction 1 and the medical pump 602 are clicked one after

another, whereby an infusion line 110b is formed from the junction 1 to the medical pump 602 (FIG. 7C, S1018, S1019). In this case, the order of clicking may be reversed as well.

[0039] Subsequently, a line in which the medical pumps 603 and 604 are jointed at some midpoint and a medical fluid is injected into the patient at the left thigh part. The medical pump 603 and the junction production button 614 are clicked one after another, whereby a new junction 2 is displayed below the medical pump 603 with the junction 2 being surrounded by a circle (S1003), and an infusion line 110c is formed in the middle between the medical pump 603 and the junction 2 (FIG. 7D, S1004). Subsequently, this junction 2 and the left thigh part selection button 613 are clicked to form the second infusion line L2 from the junction 2 to the left thigh part of the patient (FIG. 7E, S1018, S1019).

[0040] Finally, the medical pump 604 and the new junction 2 are clicked one after another, thereby completing the infusion line 110c (FIG. 7F, S1018, S1019). At this time, if the operator mistakenly clicks the left thigh part selection button 607 after clicking the medical pump 604, the infusion line L2 from the medical pump 604 will directly run into the left thigh part of the patient without passing through the junction 2. If the operator notices the operational error at this time, he or she may click the return button 615.

[0041] The return button is clicked once, whereby finally conducted action (clicking of the left thigh part selection button in this case) is determined as being invalid, and the state in which the medical pump 604 is selected is provided. The operator clicks the right junction at this time, thereby enabling an accurate infusion line to be created. It is also made possible to confirm at a glance the respective medical pumps 601 to 604 and intravenous injection points 606 to 613 of the patient. The operator clicks the end button 616 after confirmation. Through this operation, the created diagram of infusion circuitry is created as a bmp file format, and is stored in the name of "C:¥Yuekic.bmp".

[0042] Furthermore, although not described in this embodiment, an interruption button for interrupting processing to end the infusion circuitry creation function may be provided. In this embodiment, the junction is considered as a point, but in the case where transfusion using three-way stop cocks, Yshaped-tubes, Tshaped-tubes and the like is conducted, a three-way stop cock button and a Yshaped-tube button are provided in place of the junction production button, thereby making it possible accommodate the situation.

[0043] Also, although only the bit map file is created in this embodiment, the history of operational actions is recorded in other format separately, thereby making it possible to cope flexibly with the situation in which infusion circuitry is slightly changed.

[0044] In the aforesaid example, six infusion lines are displayed in FIG. 6. Assuming that display of one infusion line represents one action, six actions of:

(1) drawing a line between the pump 601 and the new junction 1, (2) drawing a line between the junction 1 and the right brachium part of the patient, (3) drawing a line between the junction 1 and the pump 602, (4) drawing a line between the pump 603 and the new junction 2, (5) drawing a line between the junction 2 and the left thigh part of the patient, and (6) drawing a line between the junction 2 and the pump 604 are recorded.

[0045] The file in which the previous operational action is recorded is read at the time when an infusion circuitry creation window is displayed, the line is drawn in accordance therewith, and selection of each drawing action is enabled, thereby making it possible to cope quickly with the slight modification from the previously created circuitry. Buttons and the like in the window in that case are placed as shown in FIG. 8. In comparison with FIG. 6, the return button is absent, and a history back button 801, a history proceeding button 802 and a line deletion button 803 are newly created.

[0046] Each time the history back button is once pushed, the drawn line is selected in reverse chronological order (S1005, S1006). In the case of this embodiment, six lines are displayed at the time when the window appears, and when the history back button is once clicked, the infusion line between the right-hand junction and the pump 604 is selected. When the history back button is selected once again, the state in which the infusion line between the right-hand junction and the pump 604 is selected is released, and the infusion line between the right-hand junction and the left thigh part is selected. At this time, when the history proceeding button 802 is clicked, the state in which the infusion line between the right-hand junction and left thigh part is selected is released, and the infusion line between the right-hand junction and the pump 604 is selected (S1009, S1010). When the line deletion button 803 is clicked with the infusion line selected, the selected infusion line is erased (S1011, S1012).

[0047] When a change is to be made from the flood circuitry shown in FIG. 7 so that administration is given by the medical pump 603 to the left-hand junction rather than to the right-hand junction, the history back button is clicked three times after the time when the window appears. Thereby, the line drawn between the medical pump 603 and the right-hand junction is selected. The line deletion button is clicked in this condition, followed by clicking the medical pump 603 and the right-hand junction one after another, whereby the infusion line is drawn between the medical pump 603 and the right-hand junction (FIG. 7G). (In this case, strictly speaking, since the existence of junction between the medical pump 604 and the left thigh part is meaningless, the infusion line between the medical pump 604 and the left-hand junction and the infusion line between the left-hand junction and the left thigh part should be deleted, and then a line between the medical pump 604 and the left thigh part should

be drawn as one infusion line, but the junction causes no problems in terms of display.)

[0048] At this time, the end button is clicked, whereby a newly modified diagram of infusion circuitry is stored as a bit map file (S1013, S1017). The circle surrounding the junction is displayed in order to allow the operator to select the junction easily, and therefore information of this circle does not need to be stored at the time of storing the diagram as a bit map file.

[0049] When the end button pressed, (1) at least two lines should be connected to the junction. (2) The line should not be formed in loop-like shape. (3) Each pump should be necessarily connected to one part of the patient. (4) The number of lines running directly from the pump should be less than two. Determination on these conditions is performed by determining means in the controller (S1014), and processing of displaying an error massage if the condition is satisfied is added (S1015, S1016), thereby making it possible to eliminate operating errors at the time of creating the infusion circuitry diagram and operators mistakes.

[0050] The infusion circuitry creation function is ended after the bit map file is stored (S1017) and normal pump monitor processing is carried out, but at this time, processing of updating the infusion circuitry diagram display region 540 to the new bit map file is carried out.

[0051] The administration pass to the patient is selected from a plurality of buttons in this embodiment, but this is for the purpose of easy determination of the position of the line, and if it is desired that more detailed positions are identified, methods in which the number of buttons is further increased, click is made directly on the model picture of the patient, and so on can also be adopted.

[0052] In this way, a relatively simple infusion circuitry diagram can be created, but in the case where blood filters and the like are connected in the infusion circuitry, the fluid is passed through an apparatus that is not monitored by the medical pump monitor before being injected, and so on, creation of infusion circuitry diagram by the aforesaid procedure may be complicated. In this case, it can be considered that a handwritten diagram of infusion circuitry is placed near the medical pump to make a check, but there is also a possibility of loss and so on. In this case, it is also possible to read the handwritten diagram of infusion circuitry and display the diagram. The infusion circuitry diagram read function start button 542 is clicked, whereby the scanner 102 is controlled from the controller 100, and the circuitry diagram set in the scanner 102 is read in the system, and is stored in a format as in the case of the creation of infusion circuitry described previously and in the same name of "C:¥Yuekic.bmp". Thereby, the system can create the infusion circuitry diagram using the creation function, and display/manage the diagram without classifying cases either when a registration is made or when the scanner 102 is used to read the diagram for making a registration.

[0053] Also, the scanner 102 is used as means for capturing an infusion circuitry diagram such as a handwritten diagram in this embodiment, but it is apparent that similar effects can be obtained by photographing the handwritten infusion circuitry diagram by a digital camera and having the memory medium of the digital camera read by the controller.

[0054] It is also possible to use a general graphic drawing application to create an infusion circuitry diagram and store the same as a bit map file, thereby displaying the infusion circuitry created by the graphic drawing application in this system.

[0055] According to the medical pump system of the present invention, it is possible to provide a system in which the operation conditions of a plurality of medical pumps are monitored for one patient with a function of creating and editing an infusion line from the pump to the patient on each-by-each basis, and display information created and edited by means of this function displayed on the system, thus making it much easier to confirm (monitor) the current states of infusion lines.

[0056] Other functions of the medical pump system of the present invention will be described. FIGS. 11A to 11C show a trend graph of the amount of water displayed after computing the total of the amount of water introduced by all the medical pumps that are used (Intake) and the amount of water discharged as urine (Output) is shown. The range of ml/h can be changed by pressing (clicking) a "+" or "-" key. Also, the amount of water in any time range can be displayed by using "←" or "→". FIG. 11A shows a trend graph of the balance of water (Intake and Output) at the current time. Since it is difficult to understand at a glance the totalized water balance between two arbitrary points (for example, between 11:30 and 13:00) in the graph, two arbitrary points (11:30 and 13:00) are clicked, whereby the balance of the arbitrarily designated segment (between 11:30 and 13:00) can be computed and displayed. The operator first clicks a start point of totalizing computation (11:00 in this case) on the graph. In this figure, when a point near the : 11:00 is clicked, a vertical line is displayed in the position of 11:00 (FIG. 11B). Then, when the operator clicks an end point of totalizing computation (13:00 in this case) on the graph (FIG. 11B), a sub-window appears on the graph, and time of totalizing computation and Intake and Output for the arbitrary segment are displayed therein (FIG. 11C). When a "close" button in the sub-window is clicked, the sub-window disappears and the normal state in which the graph is displayed (FIG. 11A) is restored. Also, these totals and trend graphs can be used as diagnostic/therapeutic data at different location by downloading them to the FD 906a or sending them to the host computer or the like through the external port 107a.

[0057] FIG. 12A to 12C show a trend graph of the amount of Na+ as one example of electrolytes displayed after computing the total of the electrolytes (Na^+, Ca^{2+}, K^+, Cl^-, etc.) introduced by all the medical pumps that are used or computing the data from the sensor 112. The range of mEg can be changed by pressing a "+" or "-" key. Also, the amount of electrolytes in an arbitrary time

range can be displayed by performing operations similar to those in FIGS. 11A to 11C and using "←" and "→". Also, these totals and trend graphs can be used as diagnostic/therapeutic data at different location by downloading them to the FD 906a or sending them to the host computer or the like through the external port 107a. An alarm is given when the amount of the electrolyte exceeds a preset input value (threshold). The screen may be reduced into quarters to display the amounts of four electrolytes of Na^+, Ca^{2+}, K^+, Cl^-.

Claims

1. A medical pump monitor system for monitoring a plurality of medical pumps (103-106) adapted to administer medical fluids and the like to a patient, said monitor system having a controller (100) connected to said pumps (103-106) via cable communication and/or wireless communication for monitoring flows of fluids delivered by said pumps and alarm information of said pumps, said monitor system further having a monitor screen (101),
characterised in that said controller includes infusion circuitry creating means for creating, under control of an operator of the monitor system, data defining an infusion circuitry diagrammatic image (540) showing connection conditions of infusion lines (110) from said pumps (103-106) to a patient and fluid administration paths and/or administration positions for the patient, and **in that** said controller further includes means for displaying said image (540) using said data, on said monitor screen (101).

2. The medical pump monitor system according to claim 1, wherein reading means for reading an infusion circuitry diagram such as a handwritten diagram into the medical pump monitor system is provided, and said controller (100) has means enabling a choice by an operator whether infusion circuitry information displayed on said monitor (101) during operation of the medical pump monitor system is said image (540) created by the infusion circuitry creating means or information created using said infusion circuitry diagram reading means.

3. The medical pump monitor system according to claim 1 of 2, wherein said infusion circuitry creating means displays a sketch of the patient with respect to determination of the administration position for the patient, and inputting in the medical pump monitor system any position information in the sketch, thereby making a determination as administration closest to the inputted position information.

4. The medical pump monitor system according to any one or claims 1 to 3, wherein said infusion circuitry creating means further comprises determining means for making a check for an infusion line not suited to a practical method for infusion.

5. The medical pump monitor system according to any one of claims 1 to 4, wherein said infusion circuitry creating means is arranged to select an optimal pump arrangement pattern from a plurality of pump arrangement patterns registered in advance.

6. The medical pump monitor system according to claim 4, wherein said determining means is arranged to make a determination of existence of loop-shaped lines in the infusion circuitry image, and to give an alarm to the operator is there exist a loop shaped line.

7. The medical pump monitor system according to claim 4, wherein said determining means is arranged to determine whether two or more of the infusion lines in said image (540) run directly from one said medical pump, and to give an alarm to the operator if two or more of infusion lines run directly therefrom.

8. The medical pump monitor system according to claim 4, wherein said determining means is arranged to determine whether an infusion line in said image (540) is ended at some midpoint without reaching the patient, and to give an alarm to the operator of the medical pump monitor system if the infusion line is ended at some midpoint.

9. The medical pump monitor system according to claim 4, wherein said determining means is arranged to determine whether an infusion line in said image (540) is necessarily formed towards at least one position of the patient from one said pump, and to give an alarm to the operator if the infusion line is not necessarily formed towards at least one position of the patient from the medical pump.

10. The medical pump monitor system according to claim 4, wherein said determining means is arranged to determine whether an infusion line in said image (540) inserted into a specified portion of the patient is inserted into the patient again, and to give an alarm to the operator if the infusion line inserted into a specified portion of the patient is inserted into the patient again.

11. The medical pump monitor system according to claim 4, wherein said determining means is arranged to determine whether an infusion line from one said operating medical pump is not connected to the patient, and to give an alarm to the operator if the infusion line from the operating medical pump is not connected to the patient.

12. The medical pump monitor system according to any one of claims 1 to 11, including means for displaying

on said monitor screen real-time states or trends in selected time ranges for at least any one of the amount of water input to the patient by the pumps, the urinary volume of the patient and the amount of electrolytes introduced to the patient by the pumps.

Patentansprüche

1. Überwachungssystem für eine medizinische Pumpe zur Überwachung einer Vielzahl an medizinischen Pumpen (103-106), die ausgebildet sind, um medizinische Fluide und dergleichen einem Patienten zu verabreichen, wobei das Überwachungssystem einen Steuerteil (100) aufweist, der mit den Pumpen (103-106) mittels Kabelkommunikation und/oder Drahtloskommunikation verbunden ist, um von den Pumpen gelieferte Fluidströme und Alarminformation der Pumpen zu überwachen, wobei das Überwachungssystem ferner einen Überwachungsbildschirm (101) aufweist,
dadurch gekennzeichnet, dass der Steuerteil ein Infusionskreislauf-Erzeugungsmittel umfasst, um unter Überwachung durch eine Bedienperson des Überwachungssystems Daten zu erzeugen, die eine Infusionskreislauf-Diagrammdarstellung (540) definieren, welche Verbindungsbedingungen von Infusionsleitungen (110) von den Pumpen (103-106) zu einem Patienten und Fluidverabreichungswege und/oder Verabreichungspositionen für den Patienten anzeigt, und dass der Steuerteil ferner ein Mittel zur Anzeige der genannten Darstellung (540) unter Verwendung der Daten auf dem Überwachungsbildschirm (101) umfasst.

2. Überwachungssystem für eine medizinische Pumpe nach Anspruch 1, worin ein Lesemittel zum Einlesen eines Infusionskreislaufdiagramms, wie z.B. eines handgeschriebenen Diagramms, in das Überwachungssystem für eine medizinische Pumpe bereitgestellt ist und der Steuerteil (100) ein Mittel aufweist, welches es einer Bedienperson ermöglicht, eine Auswahl zu treffen, ob die auf dem Bildschirm (101) angezeigte Information im Betriebszustand des Überwachungssystems für eine medizinische Pumpe jene Darstellung (540) ist, die durch das Infusionskreislauf-Erzeugungsmittel erzeugt wird oder jene Information ist, die unter Verwendung des Infusionskreislauf-Diagrammeinlesemittel erzeugt wird.

3. Überwachungssystem für eine medizinische Pumpe nach Anspruch 1 oder 2, worin das Infusionskreislauf-Erzeugungsmittel eine Zeichnung des Patienten bezüglich der Bestimmung der Verabreichungsposition für den Patienten anzeigt und jede Positionsinformation in der Zeichnung in das Überwachungssystem für eine medizinische Pumpe eingibt, wodurch die Verabreichung bestimmt wird, die am nächsten zur eingegebenen Positionsinformation ist.

4. Überwachungssystem für eine medizinische Pumpe nach einem der Ansprüche 1 bis 3, worin das Infusionskreislauf-Erzeugungsmittel ferner ein Bestimmungsmittel umfasst, das zur Suche einer Infusionsleitung dient, die für ein praktisches Infusionsverfahren nicht geeignet ist.

5. Überwachungssystem für eine medizinische Pumpe nach einem der Ansprüche 1 bis 4, worin das Infusionskreislauf-Erzeugungsmittel angeordnet ist, um eine optimale Pumpanordnungsstruktur aus einer Vielzahl an im Voraus eingetragenen Pumpanordnungsstrukturen auszuwählen.

6. Überwachungssystem für eine medizinische Pumpe nach Anspruch 4, worin das Bestimmungsmittel angeordnet ist, um die Gegenwart von schleifenförmigen Leitungen in dem Infusionskreislaufbild zu bestimmen und für den Fall, dass eine schleifenförmige Leitung vorliegt, ein Alarmsignal an die Bedienperson auszugeben.

7. Überwachungssystem für eine medizinische Pumpe nach Anspruch 4, worin das Bestimmungsmittel angeordnet ist, um zu bestimmen, ob zwei oder mehrere der Infusionsleitungen in der Darstellung (540) direkt aus einer der medizinischen Pumpen führen, und für den Fall, dass zwei oder mehrere der Infusionsleitungen direkt aus diesen führen, ein Alarmsignal an die Bedienperson auszugeben.

8. Überwachungssystem für eine medizinische Pumpe nach Anspruch 4, worin das Bestimmungsmittel angeordnet ist, um zu bestimmen, ob eine Infusionsleitung in der Darstellung (540) an irgendeinem Mittelpunkt endet, ohne den Patienten zu erreichen, und für den Fall, dass die Infusionsleitung an irgendeinem Mittelpunkt endet, ein Alarmsignal an die Bedienperson des Überwachungssystems für eine medizinische Pumpe auszugeben.

9. Überwachungssystem für eine medizinische Pumpe nach Anspruch 4, worin das Bestimmungsmittel angeordnet ist, um zu bestimmen, ob eine Infusionsleitung in der Darstellung (540) aus einer der Pumpen zwingend zu zumindest einer Position des Patienten hin ausgebildet ist, und für den Fall, dass die Infusionsleitung nicht zwingend aus der medizinischen Pumpe zu zumindest einer Position des Patienten hin ausgebildet ist, ein Alarmsignal an die Bedienperson auszugeben.

10. Überwachungssystem für eine medizinische Pumpe nach Anspruch 4, worin das Bestimmungsmittel angeordnet ist, um zu bestimmen, ob eine Infusions-

leitung in der Darstellung (540), die in einen bestimmten Körperteil des Patienten eingeführt ist, erneut in den Patienten eingeführt wird, und für den Fall, dass die Infusionsleitung, welche in einen bestimmten Körperteil des Patienten eingeführt ist, erneut in den Patienten eingeführt wird, ein Alarmsignal an die Bedienperson auszugeben.

11. Überwachungssystem für eine medizinische Pumpe nach Anspruch 4, worin das Bestimmungsmittel angeordnet ist, um zu bestimmen, ob eine Infusionsleitung aus einer der sich in Betrieb befindlichen medizinischen Pumpen nicht an den Patienten angeschlossen ist.

12. Überwachungssystem für eine medizinische Pumpe nach einem der Ansprüche 1 bis 11, das Mittel zum Anzeigen von Echtzeitzuständen oder -tendenzen bezüglich zumindest einem aus der mittels Pumpen dem Patienten zugeführten Wassermenge, dem Harnvolumen des Patienten und mittels Pumpen dem Patienten zugeführten Menge an Elektrolyten in ausgewählten Zeitbereichen auf dem Überwachungsbildschirm umfasst.

Revendications

1. Système de surveillance de pompe médicale pour surveiller une pluralité de pompes médicales (103-106) aptes à administrer des fluides médicaux et analogues à un patient, ledit système de surveillance comportant un dispositif de commande (100) relié auxdites pompes (103-106) par une communication par câble et/ou une communication sans fil pour surveiller les écoulements de fluides distribués par lesdites pompes et les informations d'alarme desdites pompes, ledit système de surveillance comportant en outre un écran de surveillance (101), **caractérisé en ce que** ledit dispositif de commande comprend un moyen de création de circuit d'infusion pour créer, sous la commande d'un opérateur du système de surveillance, des données définissant une image schématique de circuit d'infusion (540) représentant les conditions de connection des conduits d'infusion (110) desdites pompes (103-106) à un patient et des chemins d'administration de fluide et/ou des positions d'administration pour le patient, et **en ce que** ledit dispositif de commande comprend en outre des moyens pour afficher ladite image (540) en utilisant lesdites données, sur ledit écran de surveillance (101).

2. Système de surveillance de pompe médicale selon la revendication 1, où un moyen de lecture pour lire un schéma de circuit d'infusion, comme un schéma écrit à la main, dans le système de surveillance de pompe médicale est prévu, et ledit dispositif de commande (100) possède un moyen permettant un choix par un opérateur, à savoir si les informations de circuit d'infusion affichées sur ledit organe de surveillance (101) pendant le fonctionnement du système de surveillance de pompe médicale est ladite image (540) créée par le moyen de création de circuit d'infusion ou l'information créée en utilisant ledit moyen de lecture de schéma de circuit d'infusion.

3. Système de surveillance de pompe médicale selon la revendication 1 ou 2, où le moyen de création de circuit d'infusion affiche un dessin à main levée du patient par rapport à la détermination de la position d'administration pour le patient, et entre dans le système de surveillance de pompe médicale toute information de position dans le dessin à main levée, en faisant ainsi une détermination comme administration la plus proche de l'information de position entrée.

4. Système de surveillance de pompe médicale selon l'une des revendications 1 à 3, où ledit moyen de création de circuit d'infusion comprend en outre un moyen de détermination pour faire une vérification dans un conduit d'infusion qui en convient pas pour un procédé d'infusion pratique.

5. Système de surveillance de pompe médicale selon l'une des revendications 1 à 4, où ledit moyen de création de circuit d'infusion est agencé pour sélectionner un motif optimal d'agencement de pompes à partir d'une pluralité de motifs d'agencement de pompes enregistrés à l'avance.

6. Système de surveillance de pompe médicale selon la revendication 4, où ledit moyen de détermination est agencé pour déterminer l'existance de conduits en forme de boucle dans l'image de circuit d'infusion, et d'émettre une alarme pour l'opérateur s'il existe un conduit en forme de boucle.

7. Système de surveillance de pompe médicale selon la revendication 4, où ledit moyen de détermination est agencé pour déterminer si deux conduits d'infusion ou plus dans ladite image (540) s'étendent directement depuis ladite pompe médicale, et d'émettre une alarme pour l'opérateur si deux conduits d'infusion ou plus s'étendent directement de celle-ci.

8. Système de surveillance de pompe médicale selon la revendication 4, où ledit moyen de détermination est agencé pour déterminer si un conduit d'infusion dans ladite image (540) se termine à un point médian sans atteindre le patient, et pour fournir une alarme à l'opérateur du système de surveillance de pompe médicale si le conduit d'infusion se termine à un point médian.

9. Système de surveillance de pompe médicale selon la revendication 4, où ledit moyen de détermination est agencé pour déterminer si un conduit d'infusion dans ladite image (540) est formé nécessairement vers au moins une position du patient depuis ladite pompe précitée, et de fournir une alarme à l'opérateur si le conduit d'infusion n'est pas nécessairement formé vers au moins une position du patient depuis la pompe médicale.

10. Système de surveillance de pompe médicale selon la revendication 4, où ledit moyen de détermination est agencé pour déterminer si un conduit d'infusion dans ladite image (540) inséré dans une portion spécifiée du patient est inséré à nouveau dans le patient, et de fournir une alarme à l'opérateur si le conduit d'infusion inséré dans une portion spécifiée du patient est inséré à nouveau dans le patient.

11. Système de surveillance de pompe médicale selon la revendication 4, où ledit moyen de détermination est agencé pour déterminer si un conduit d'infusion d'une pompe médicale fonctionnante précitée n'est pas relié au patient, et de fournir une alarme à l'opérateur si le conduit d'infusion de la pompe médicale fonctionnante n'est pas relié au patient.

12. Système de surveillance de pompe médicale selon l'une des revendications 1 à 11, incluant un moyen pour afficher sur ledit écran de surveillance des états ou tendances en temps réel dans des plages de temps sélectionnées pour au moins l'un quelconque parmi la quantité d'eau entrée dans le patient par les pompes, le volume d'urine du patient et la quantité d'électrolytes introduite dans le patient par les pompes.

FIG. 1

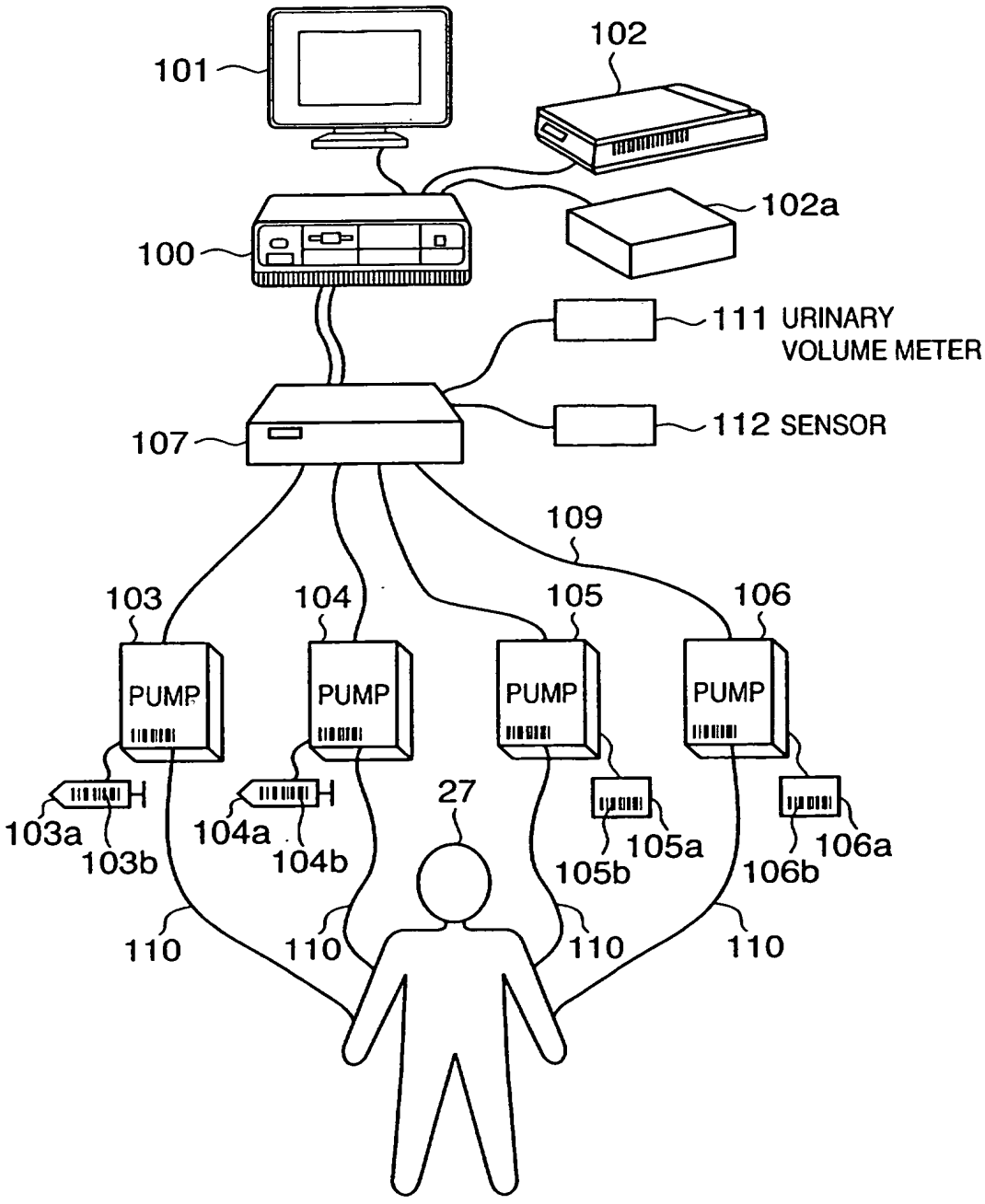

101
102
102a
100
111 URINARY VOLUME METER
107
112 SENSOR
109
103
104
105
106
PUMP
PUMP
PUMP
PUMP
103a
103b
104a
104b
27
105b
105a
106b
106a
110
110
110
110

FIG. 2

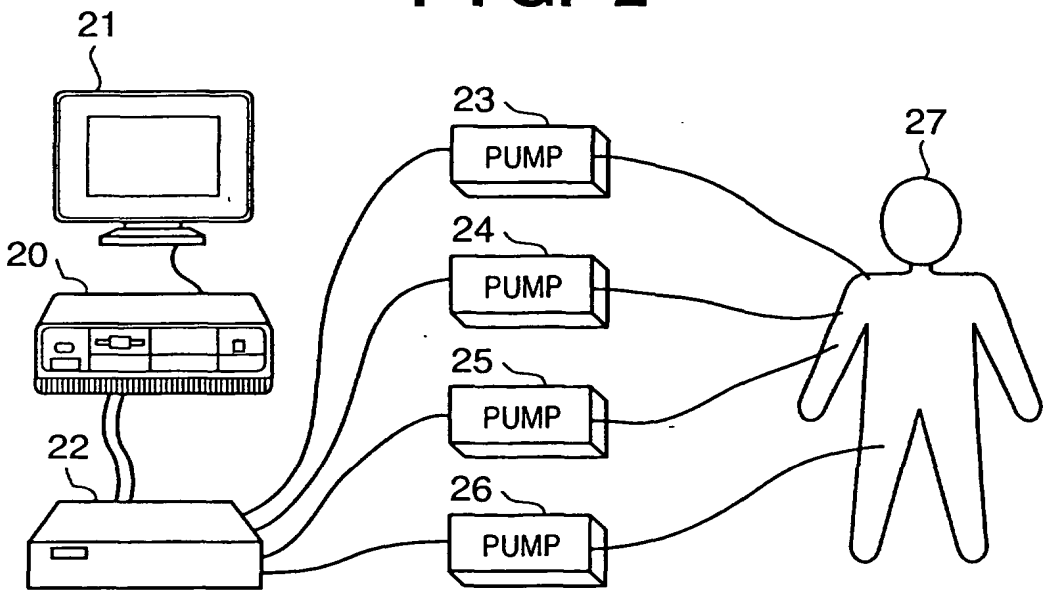

21
23
PUMP
27
20
24
PUMP
25
PUMP
22
26
PUMP

FIG. 3

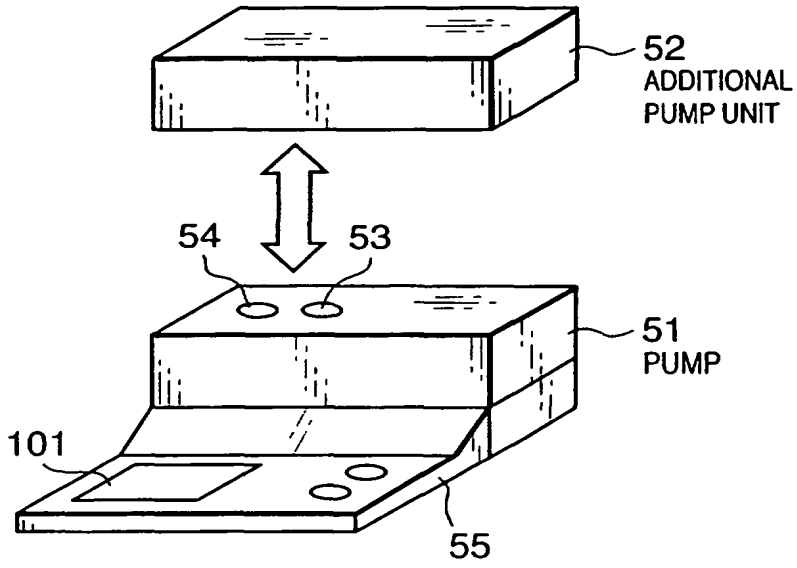

52
ADDITIONAL
PUMP UNIT
54
53
51
PUMP
101
55

FIG. 4A

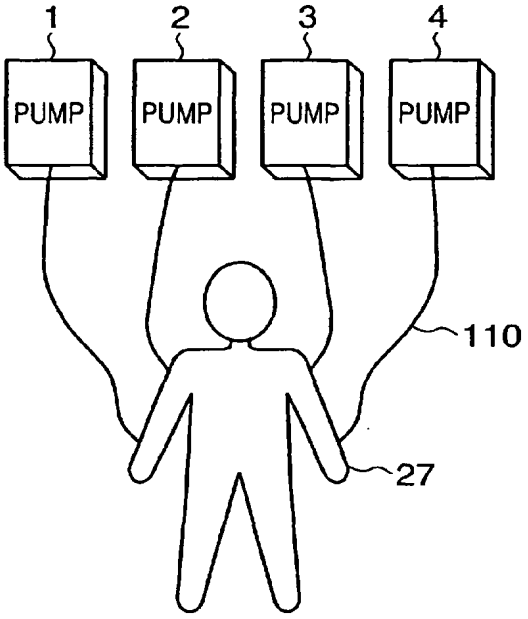


FIG. 4B

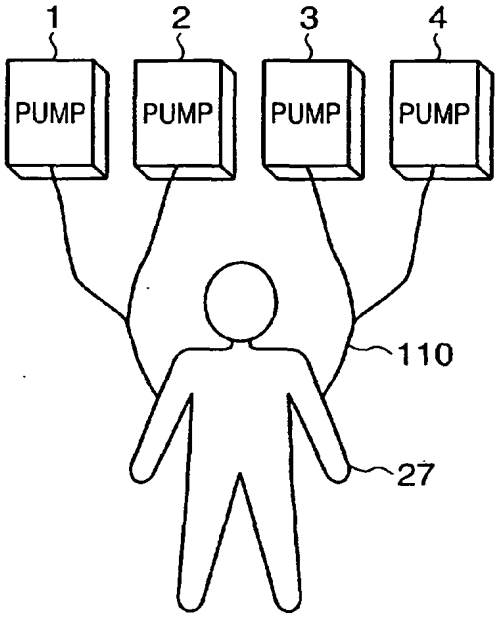


FIG. 4C

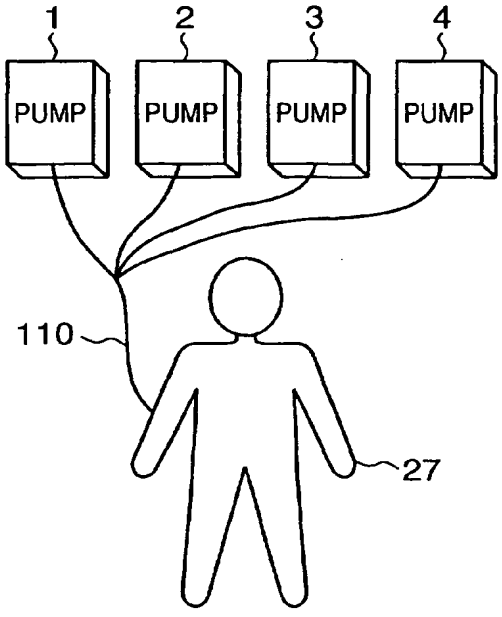
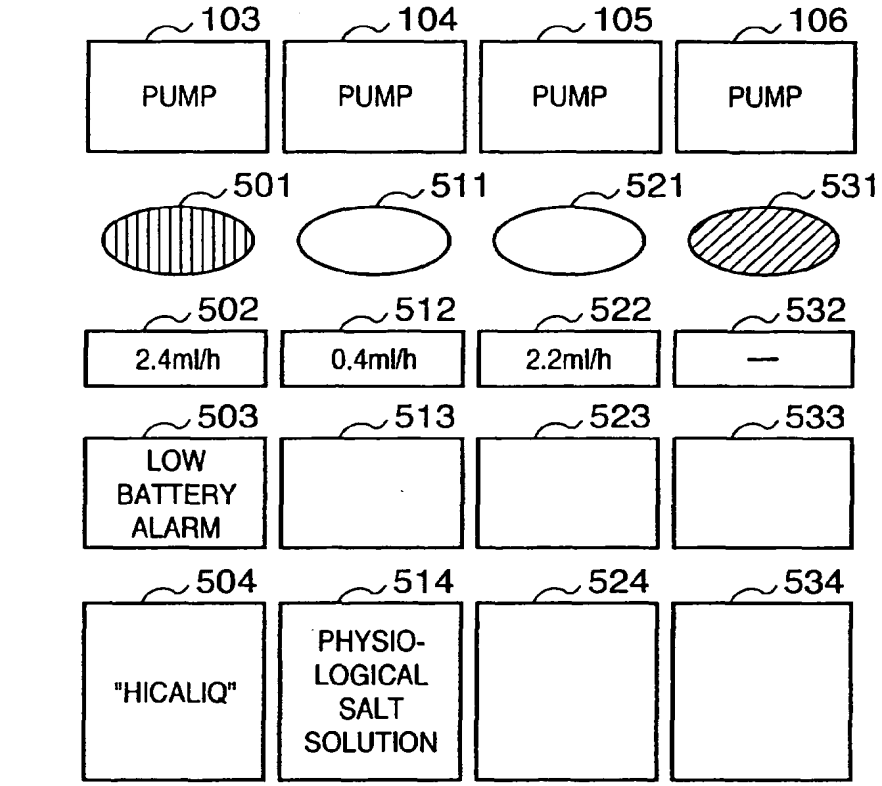


FIG. 5


103
104
105
106
PUMP
PUMP
PUMP
PUMP
501
511
521
531
502
512
522
532
2.4ml/h
0.4ml/h
2.2ml/h
—
503
513
523
533
LOW BATTERY ALARM
504
514
524
534
"HICALIQ"
PHYSIO-LOGICAL SALT SOLUTION

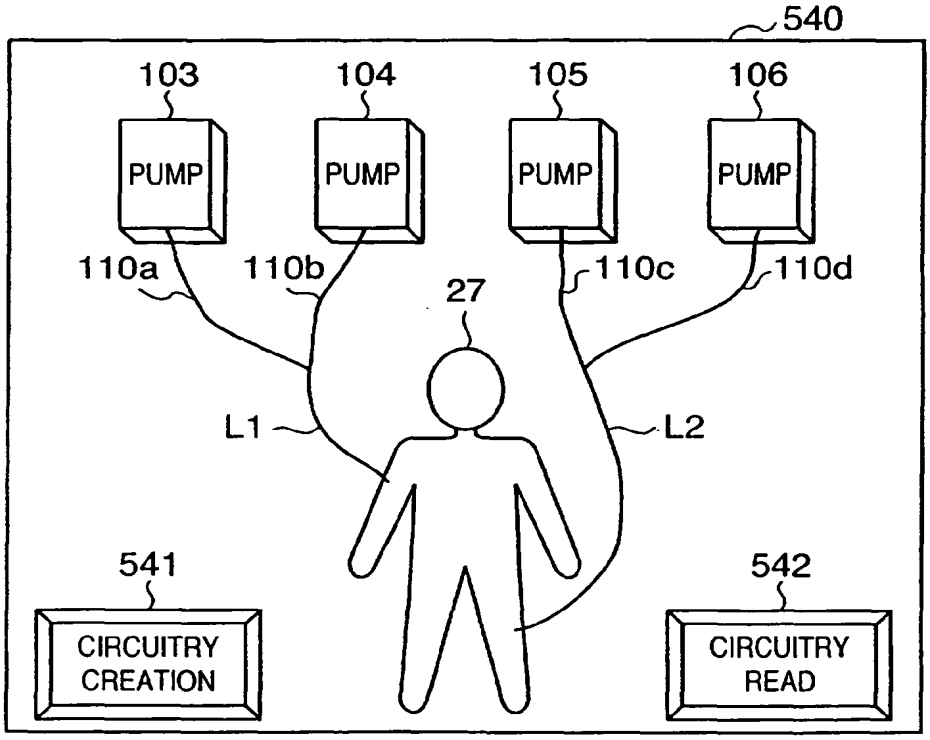

540
103
104
105
106
PUMP
PUMP
PUMP
PUMP
110a
110b
110c
110d
27
L1
L2
541
542
CIRCUITRY CREATION
CIRCUITRY READ

FIG. 6

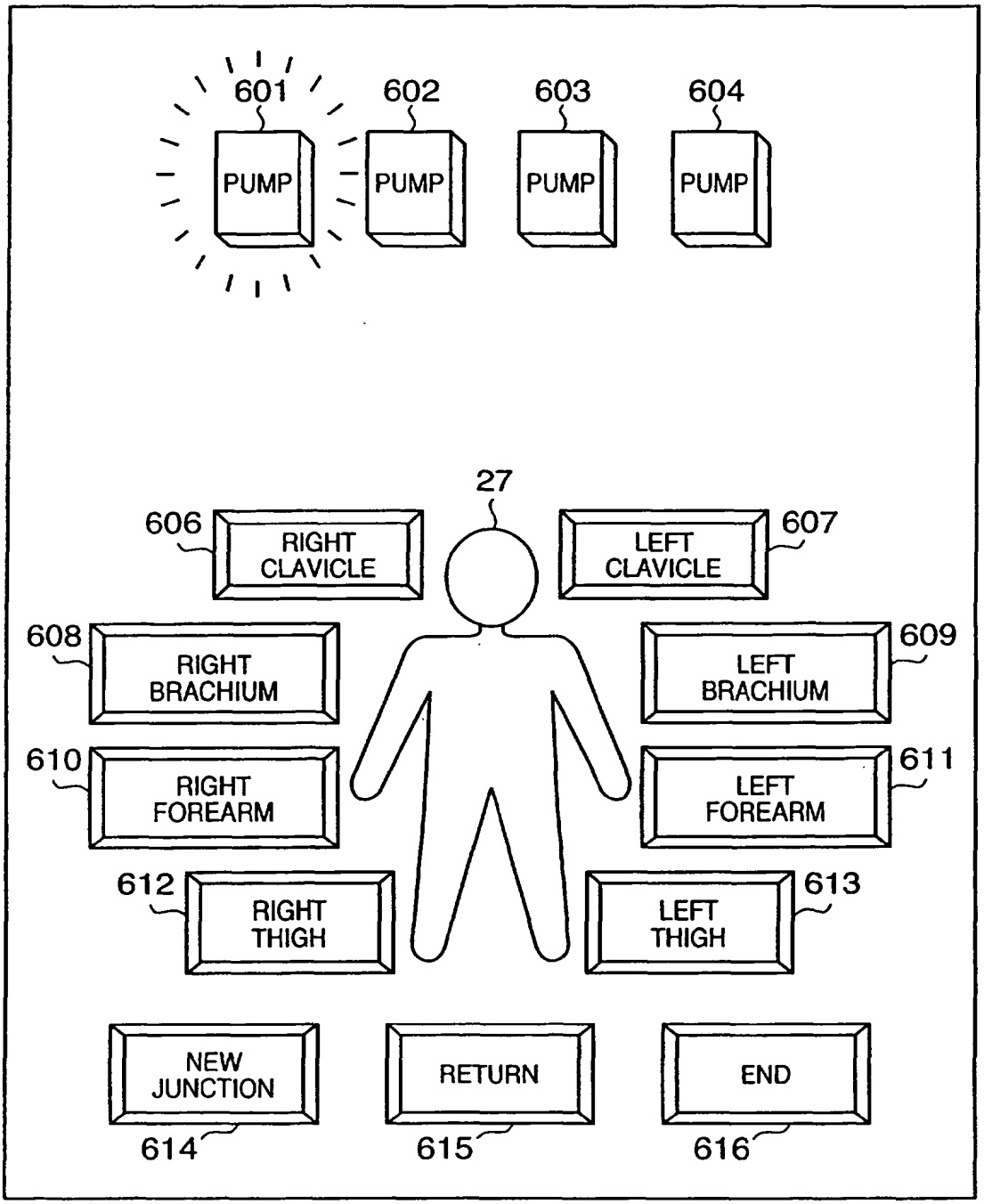

601
602
603
604
PUMP
PUMP
PUMP
PUMP
27
606
RIGHT CLAVICLE
LEFT CLAVICLE
607
608
RIGHT BRACHIUM
LEFT BRACHIUM
609
610
RIGHT FOREARM
LEFT FOREARM
611
612
RIGHT THIGH
LEFT THIGH
613
NEW JUNCTION
RETURN
END
614
615
616

FIG. 7A

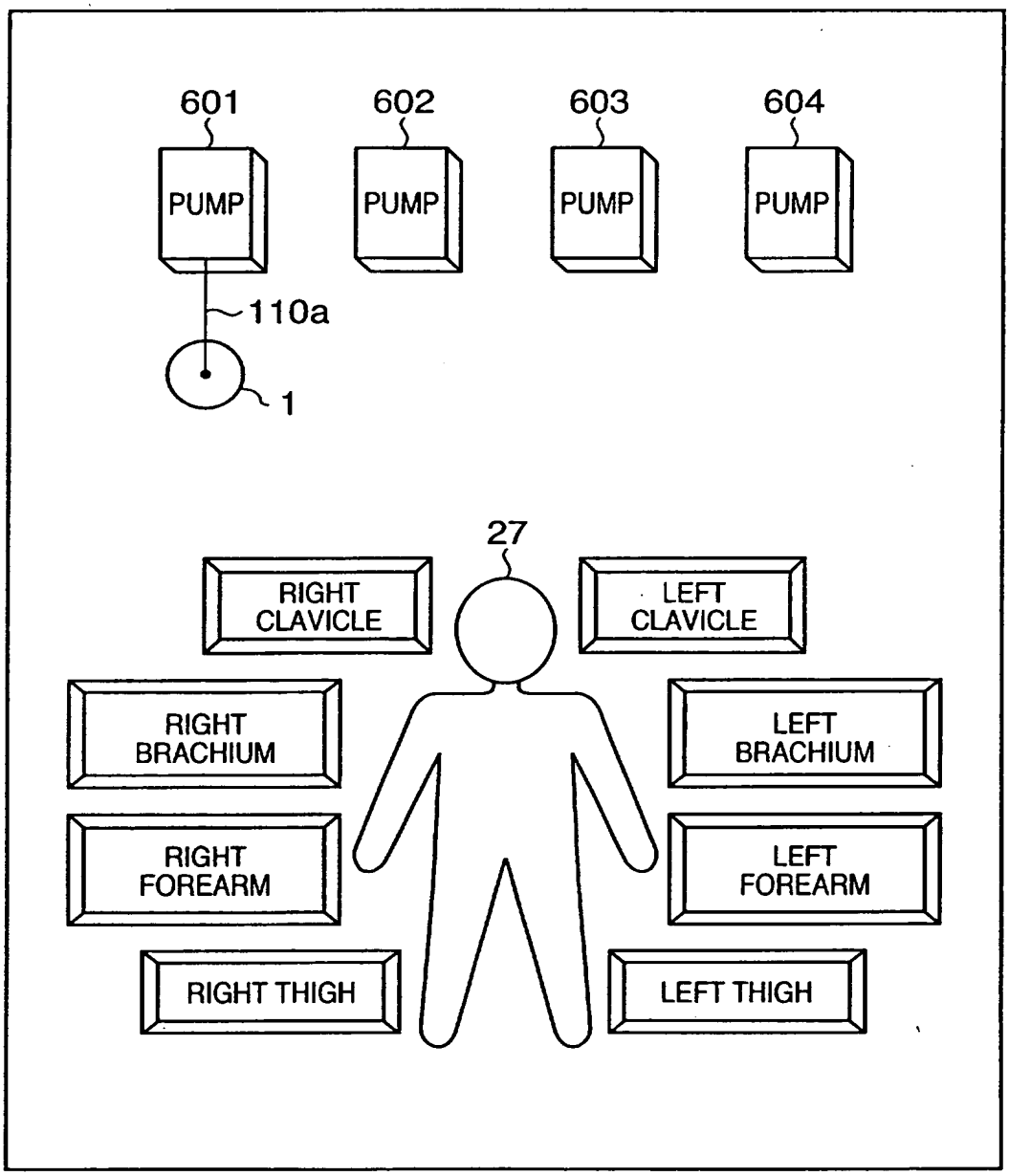

601
602
603
604
PUMP
PUMP
PUMP
PUMP
110a
1
27
RIGHT CLAVICLE
LEFT CLAVICLE
RIGHT BRACHIUM
LEFT BRACHIUM
RIGHT FOREARM
LEFT FOREARM
RIGHT THIGH
LEFT THIGH

FIG. 7B

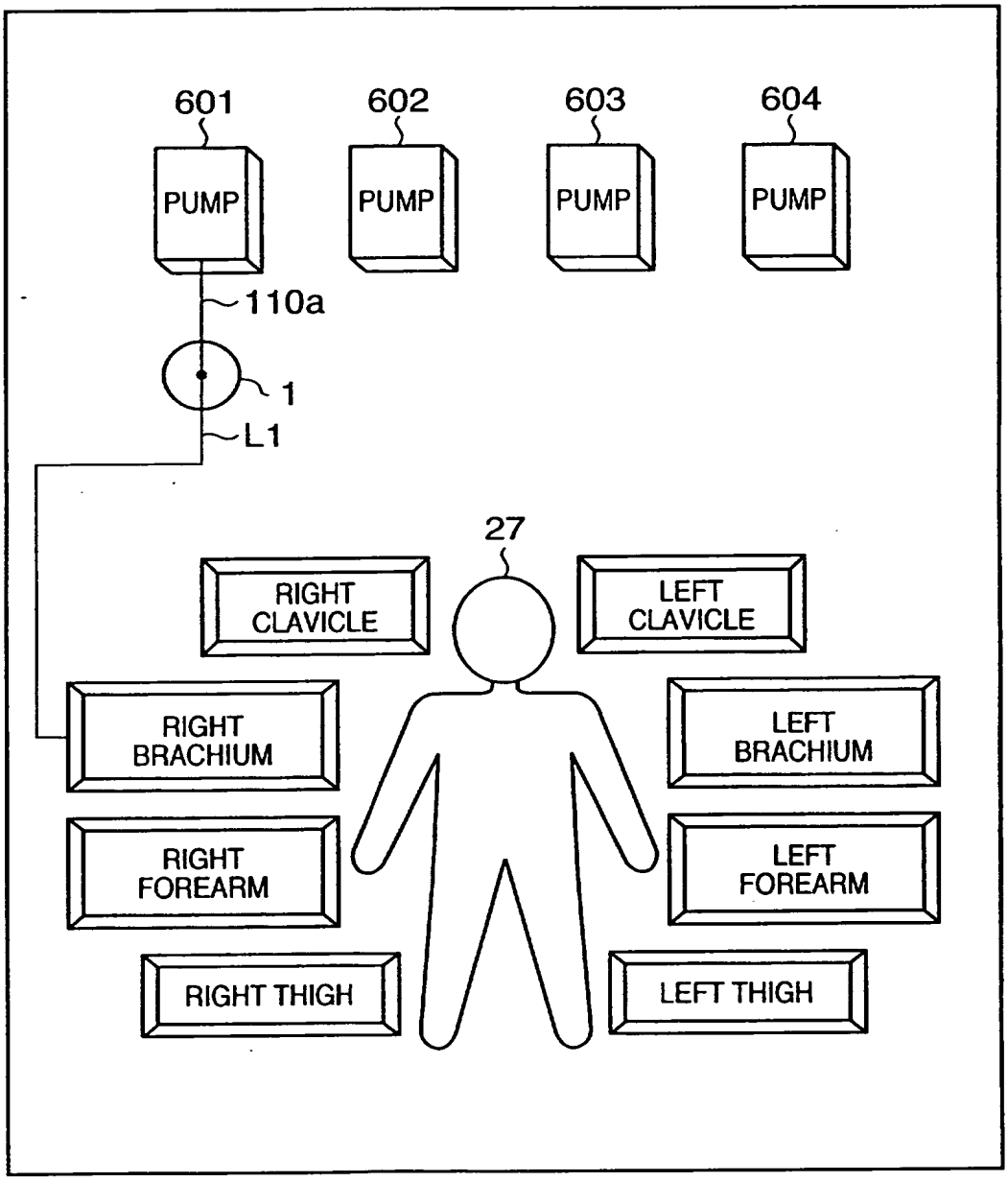

601
602
603
604
PUMP
PUMP
PUMP
PUMP
110a
1
L1
27
RIGHT CLAVICLE
LEFT CLAVICLE
RIGHT BRACHIUM
LEFT BRACHIUM
RIGHT FOREARM
LEFT FOREARM
RIGHT THIGH
LEFT THIGH

FIG. 7C

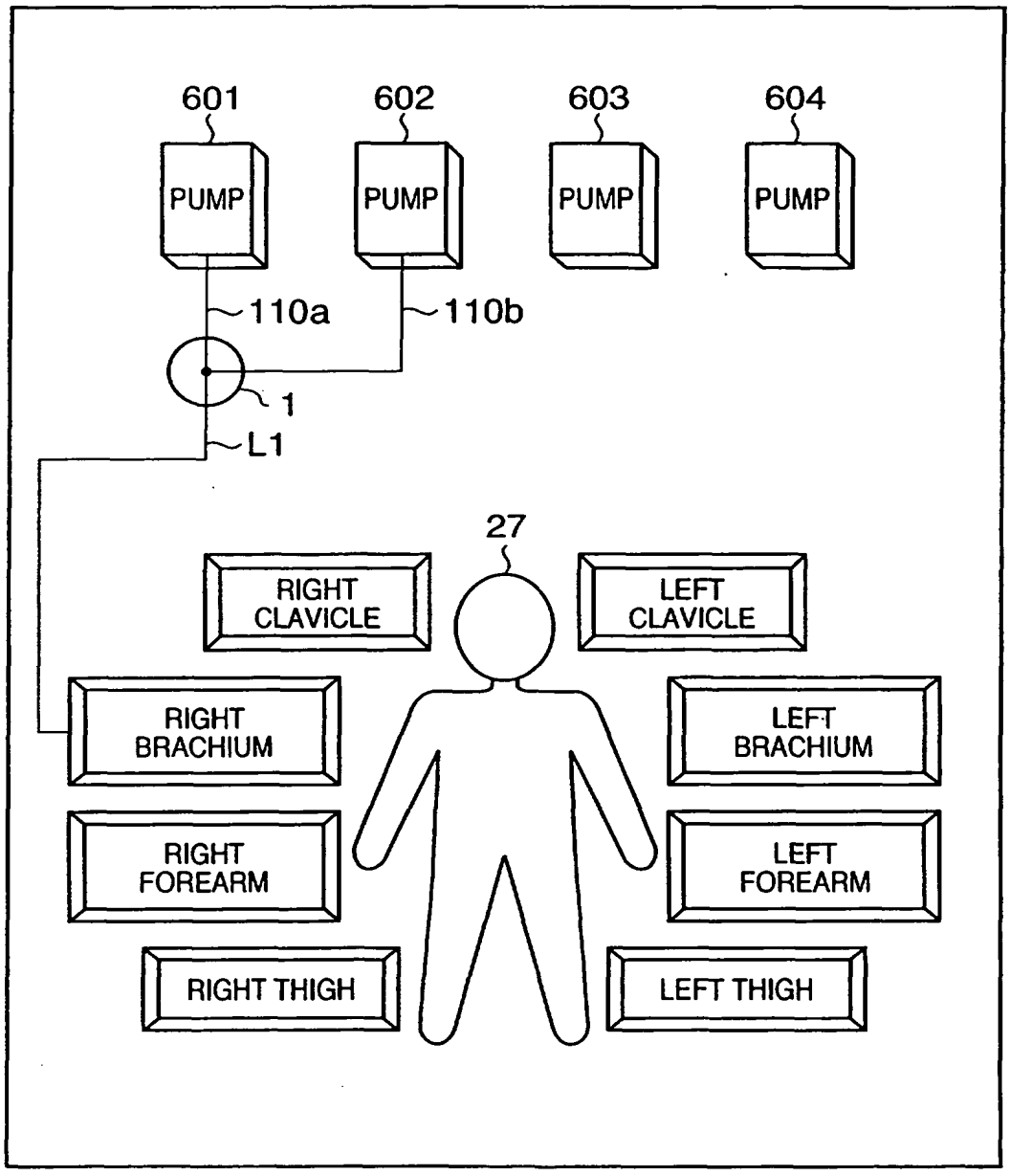

601
602
603
604
PUMP
PUMP
PUMP
PUMP
110a
110b
1
L1
27
RIGHT CLAVICLE
LEFT CLAVICLE
RIGHT BRACHIUM
LEFT BRACHIUM
RIGHT FOREARM
LEFT FOREARM
RIGHT THIGH
LEFT THIGH

FIG. 7D

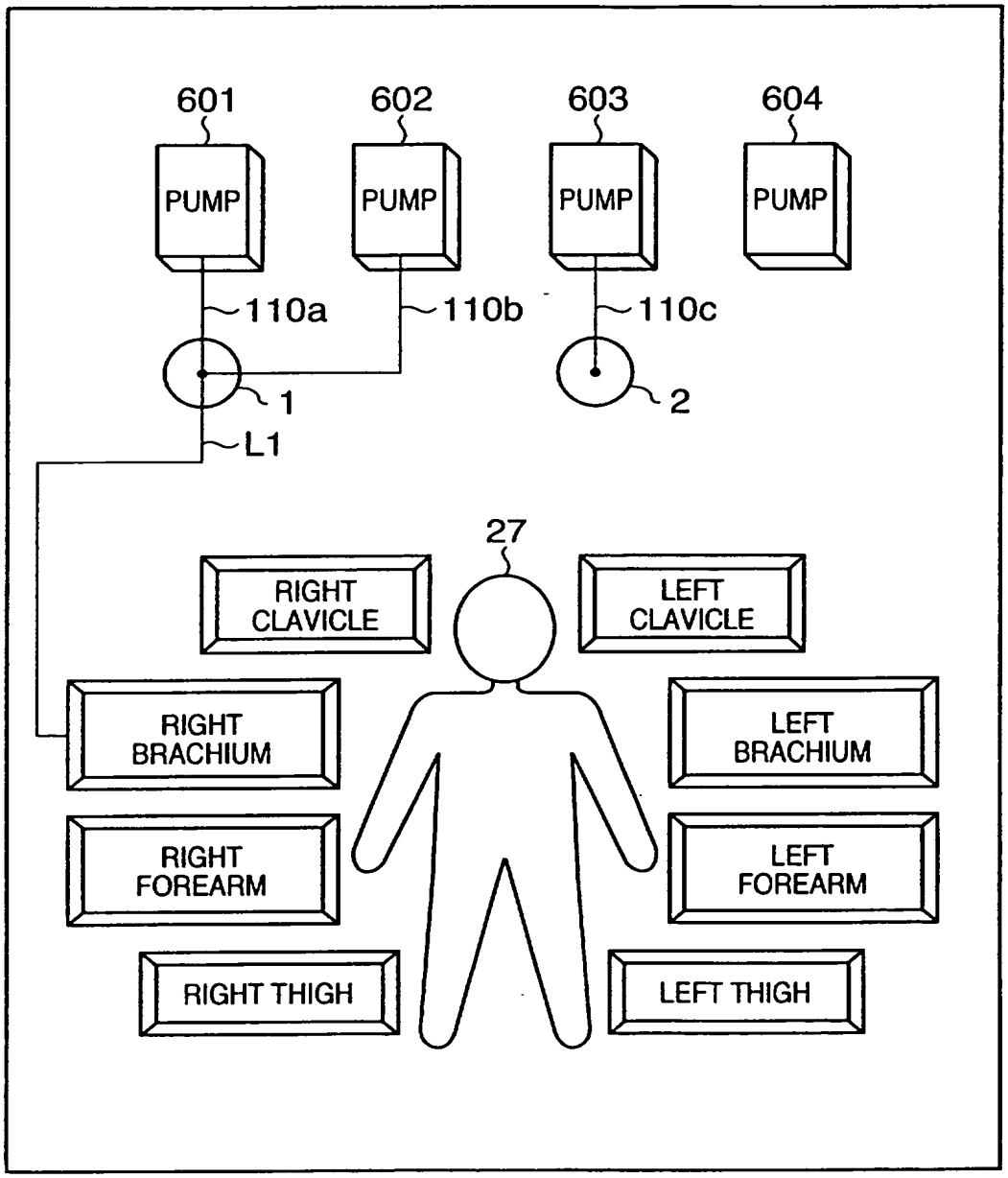

601
602
603
604
PUMP
PUMP
PUMP
PUMP
110a
110b
110c
1
2
L1
27
RIGHT CLAVICLE
LEFT CLAVICLE
RIGHT BRACHIUM
LEFT BRACHIUM
RIGHT FOREARM
LEFT FOREARM
RIGHT THIGH
LEFT THIGH

FIG. 7E

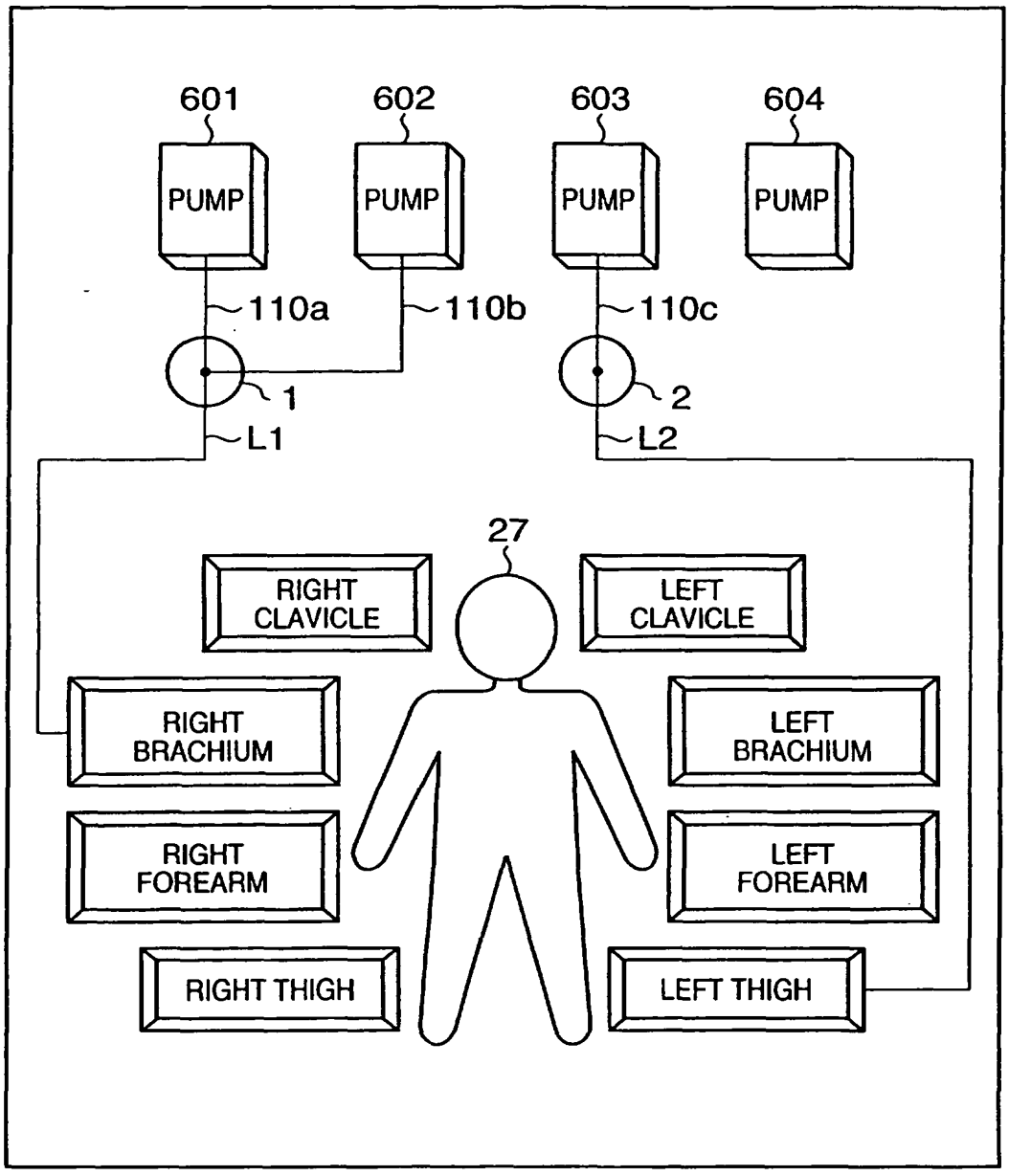

601
602
603
604
PUMP
PUMP
PUMP
PUMP
110a
110b
110c
1
2
L1
L2
27
RIGHT CLAVICLE
LEFT CLAVICLE
RIGHT BRACHIUM
LEFT BRACHIUM
RIGHT FOREARM
LEFT FOREARM
RIGHT THIGH
LEFT THIGH

FIG. 7F

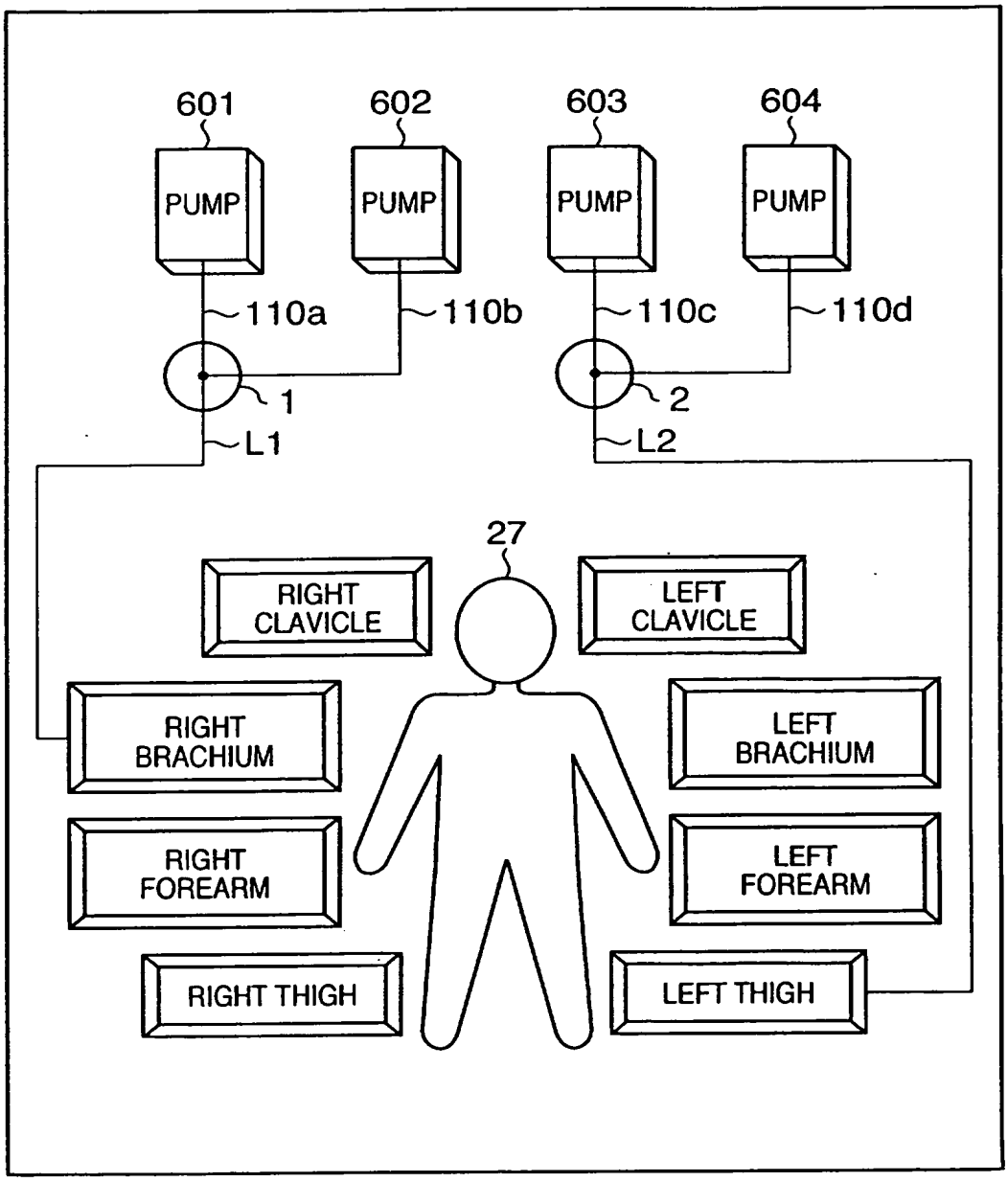

601
602
603
604
PUMP
PUMP
PUMP
PUMP
110a
110b
110c
110d
1
2
L1
L2
27
RIGHT CLAVICLE
LEFT CLAVICLE
RIGHT BRACHIUM
LEFT BRACHIUM
RIGHT FOREARM
LEFT FOREARM
RIGHT THIGH
LEFT THIGH

FIG. 7G

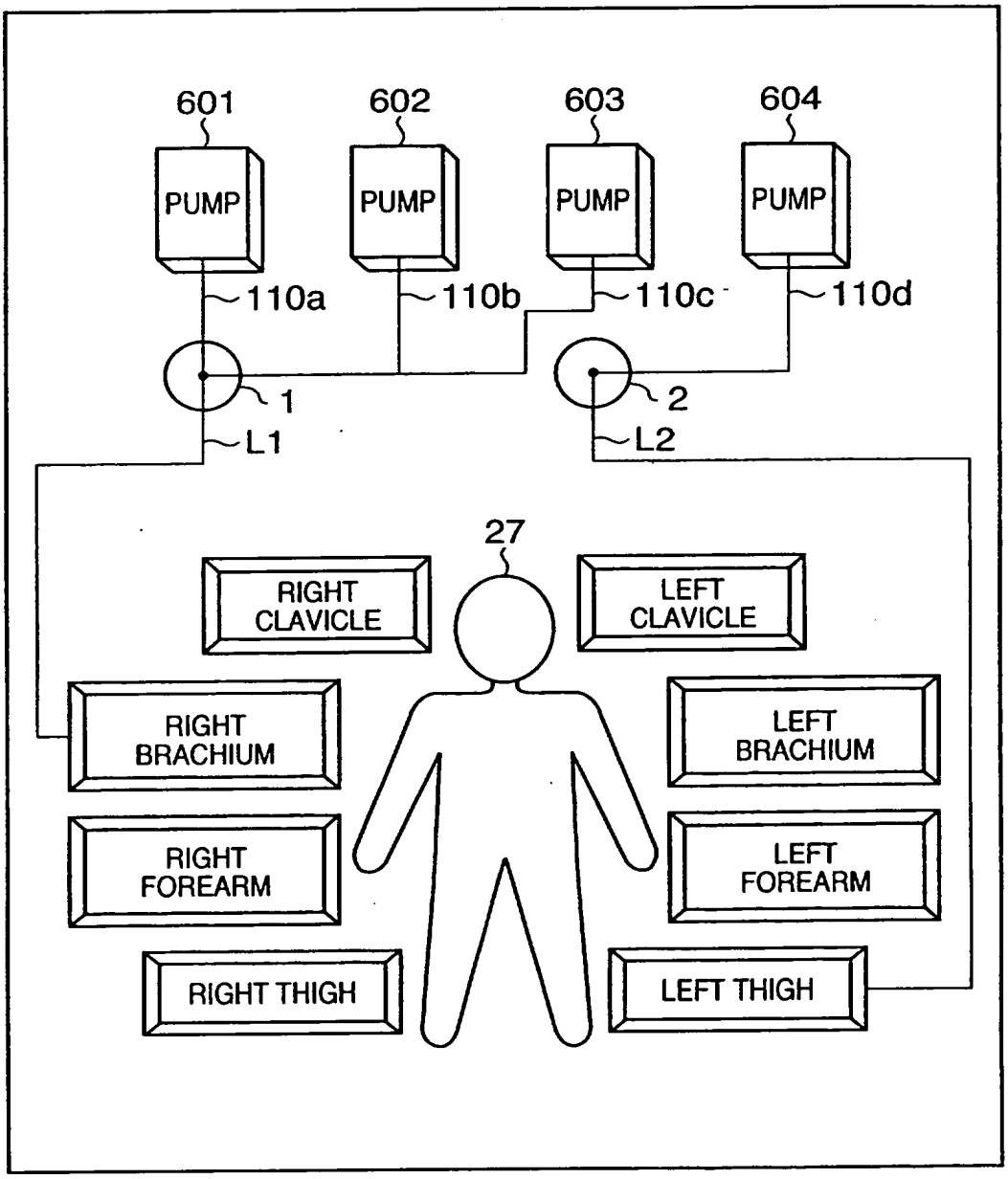

601
602
603
604
PUMP
PUMP
PUMP
PUMP
110a
110b
110c
110d
1
2
L1
L2
27
RIGHT CLAVICLE
LEFT CLAVICLE
RIGHT BRACHIUM
LEFT BRACHIUM
RIGHT FOREARM
LEFT FOREARM
RIGHT THIGH
LEFT THIGH

FIG. 8

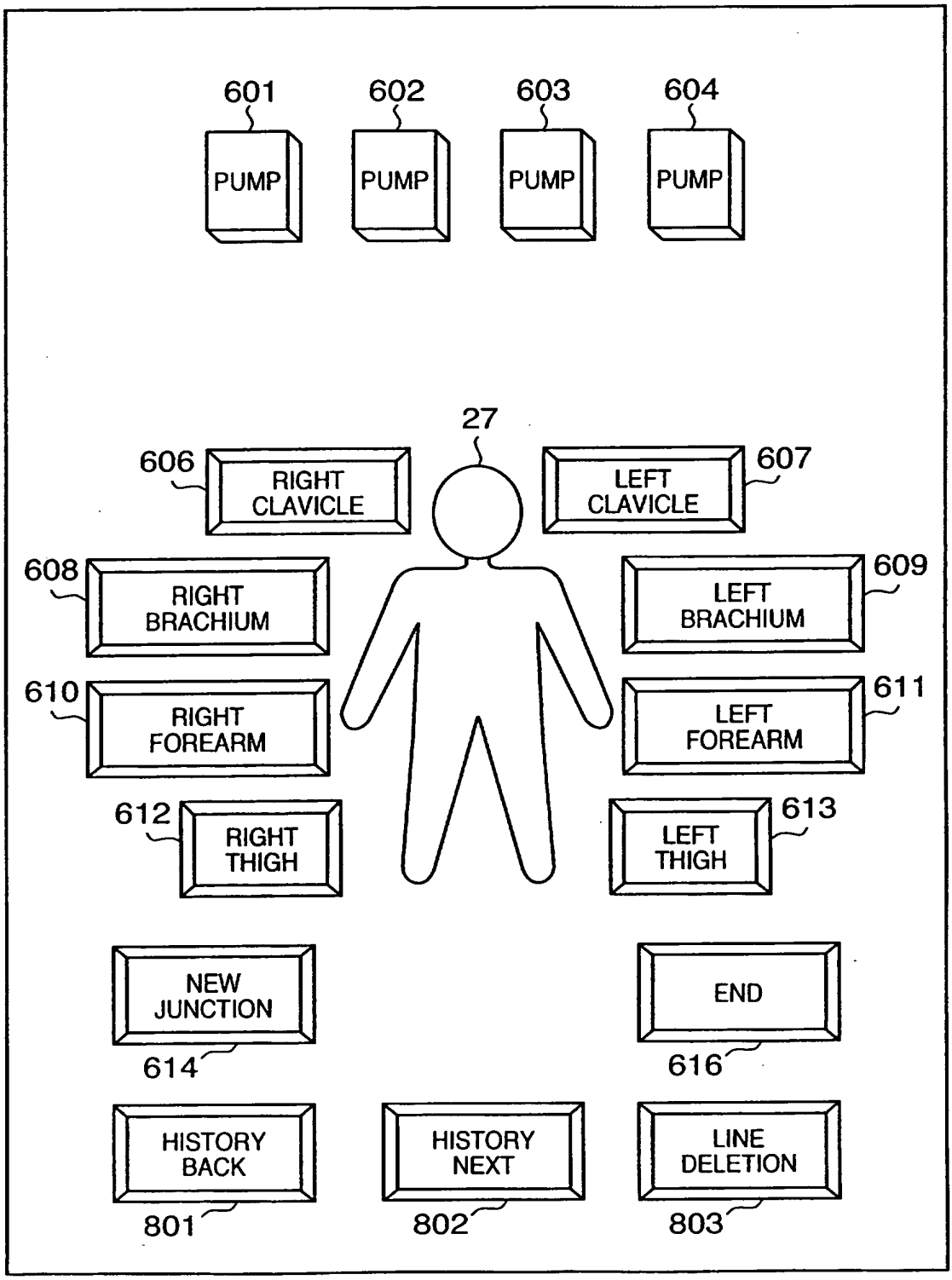

601
602
603
604
PUMP
PUMP
PUMP
PUMP
27
606
RIGHT CLAVICLE
LEFT CLAVICLE
607
608
RIGHT BRACHIUM
LEFT BRACHIUM
609
610
RIGHT FOREARM
LEFT FOREARM
611
612
RIGHT THIGH
LEFT THIGH
613
NEW JUNCTION
614
END
616
HISTORY BACK
801
HISTORY NEXT
802
LINE DELETION
803

FIG. 9

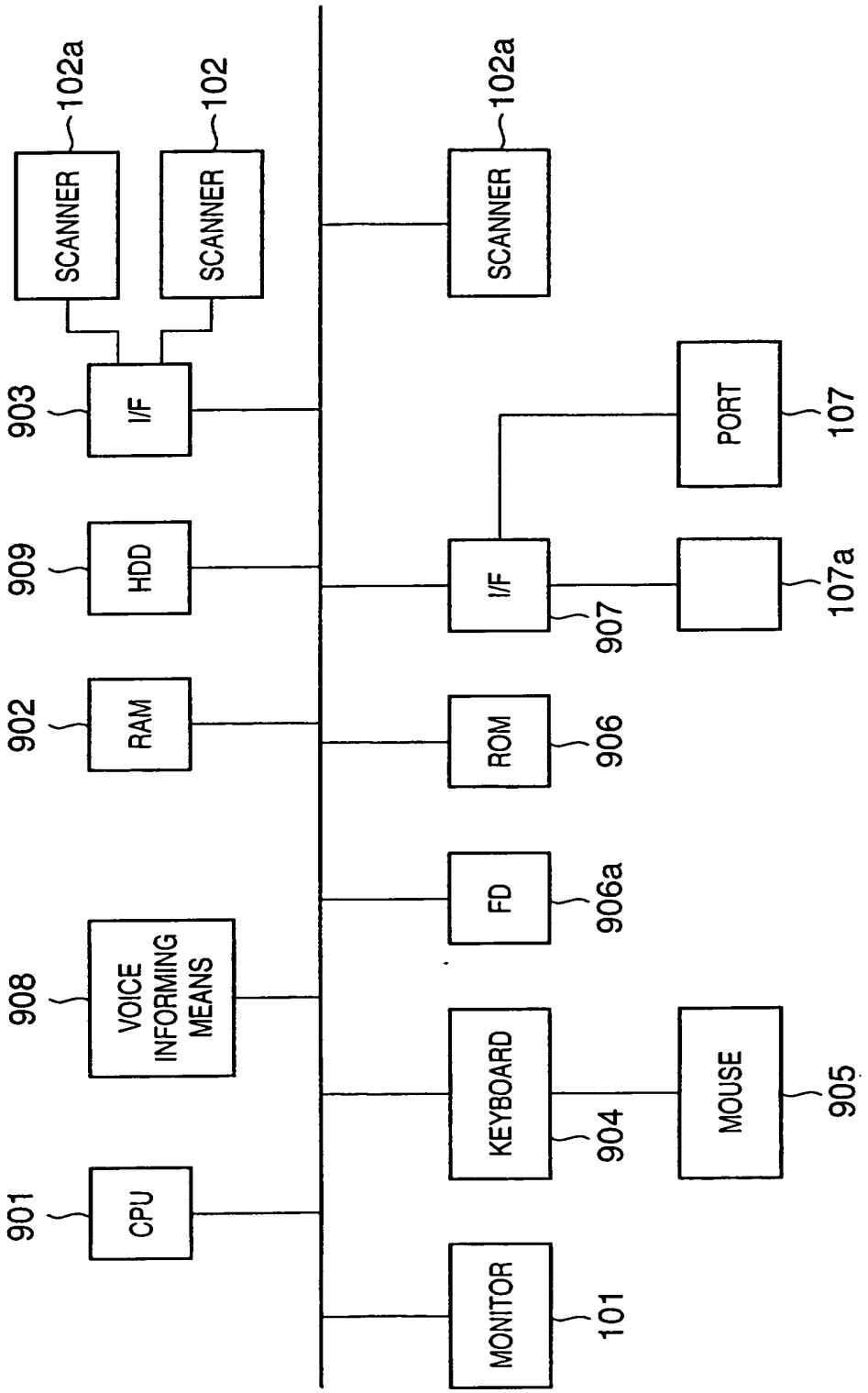

SCANNER
102a
SCANNER
102
SCANNER
102a
903
I/F
PORT
107
909
HDD
I/F
907
107a
902
RAM
ROM
906
908
VOICE INFORMING MEANS
FD
906a
KEYBOARD
904
MOUSE
905
901
CPU
MONITOR
101

FIG. 10A

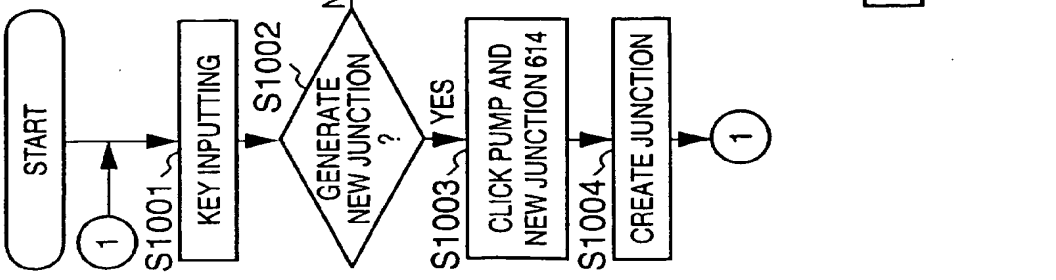


FIG. 10B

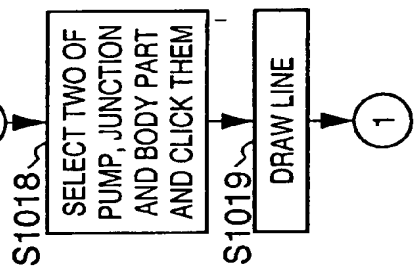


FIG. 11A

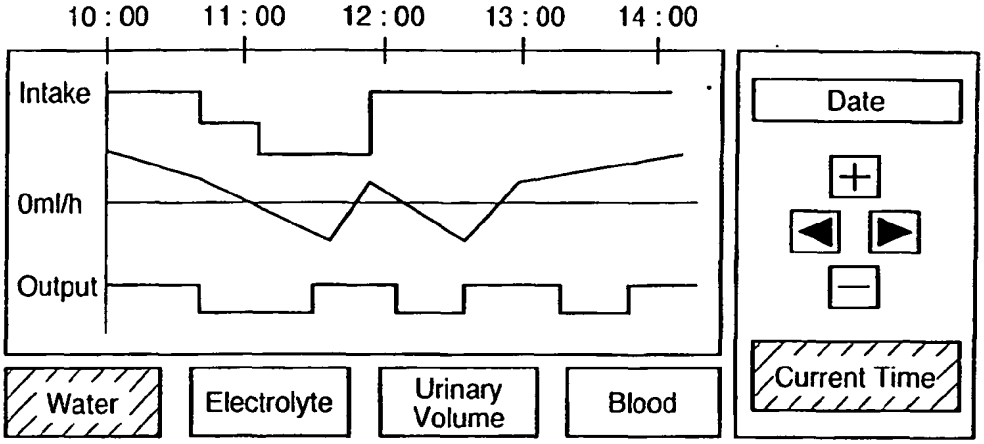


FIG. 11B

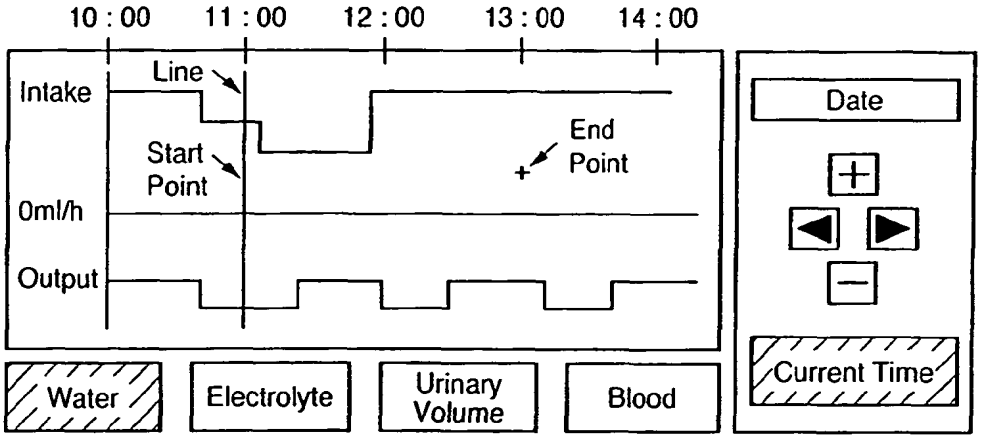


FIG. 11C

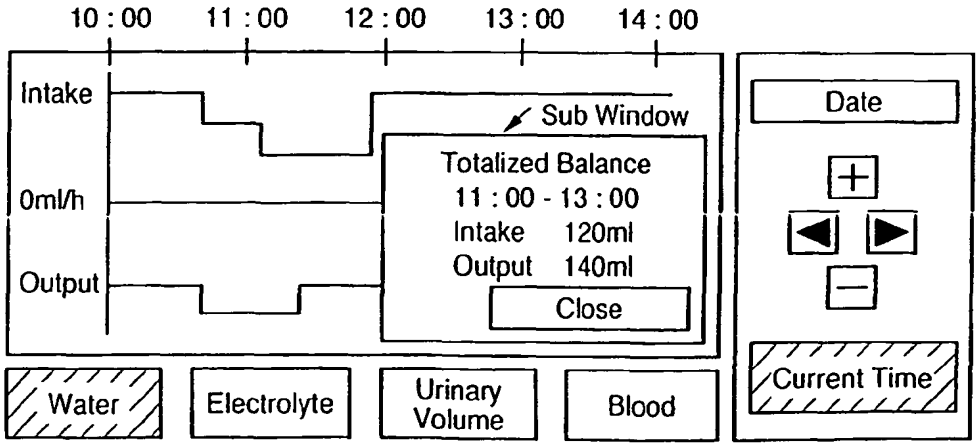


FIG. 12A

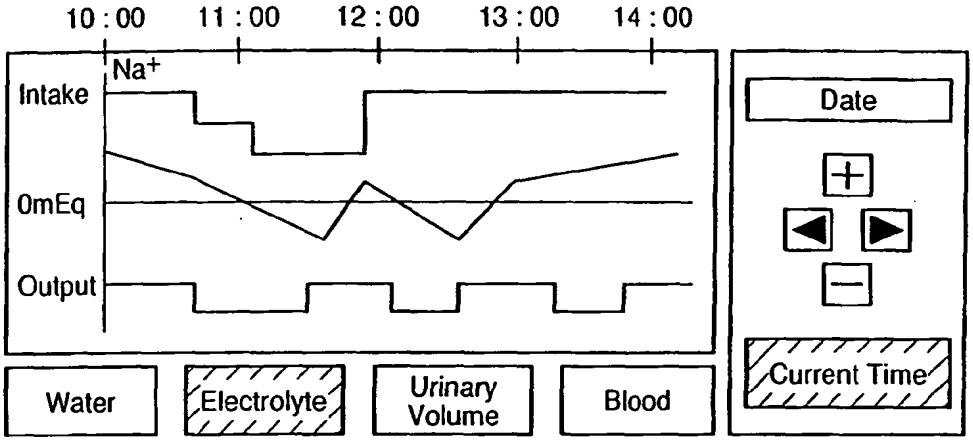


FIG. 12B

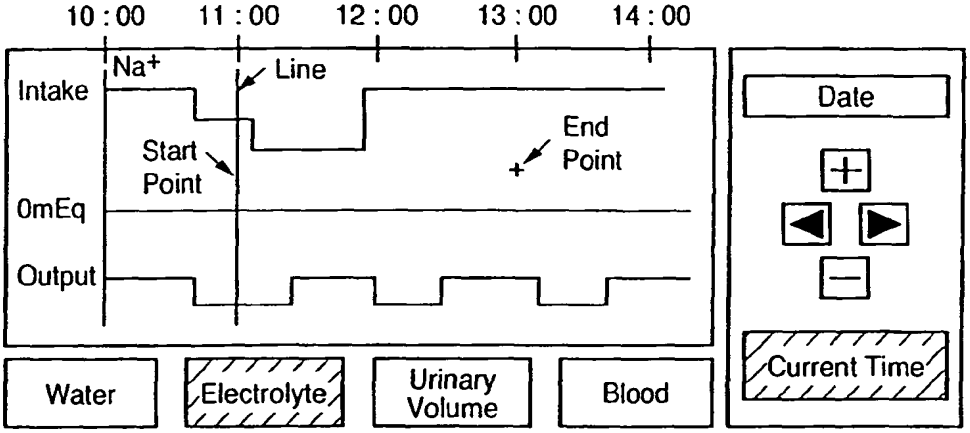
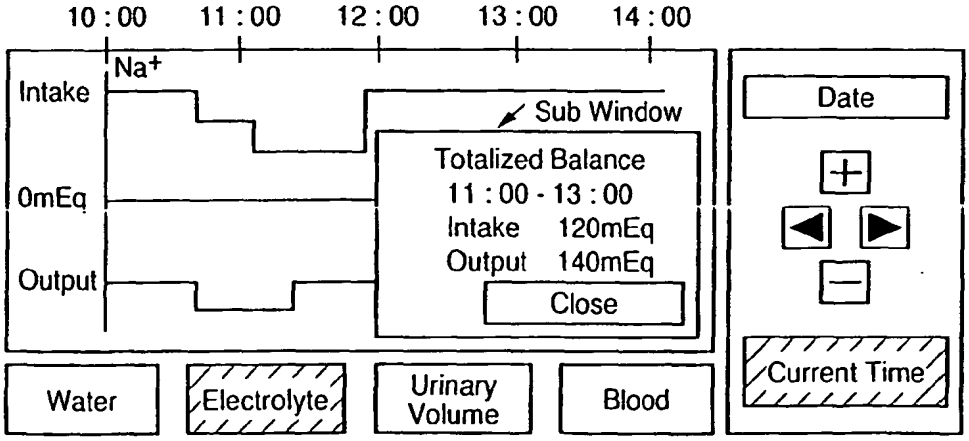


FIG. 12C



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 5007623 A **[0003] [0013]**
- EP 0960627 A **[0013]**
- US 5338157 A **[0013]**